GEOARCHAEOLOGICAL INVESTIGATION OF NATURAL FORMATION PROCESSES TO EVALUATE CONTEXT OF THE CLOVIS COMPONENT AT THE GAULT SITE (41BL323), BELL COUNTY, TEXAS

A Thesis

by

DAWN AILEEN JOYCE ALEXANDER

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF ARTS

May 2008

Major Subject: Anthropology

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Approved by:

Chair of Committee,	Michael R. Waters
Committee Members,	Harry J. Shafer
	Vatche P. Tchakerian
Head of Department,	Donny L. Hamilton

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ABSTRACT

Geoarchaeological Investigation of Natural Formation Processes to Evaluate Context of the Clovis Component at the Gault Site (41BL323), Bell County, Texas. (May 2008)

Dawn Aileen Joyce Alexander, B.A., Purdue University

Chair of Advisory Committee: Dr. Michael R. Waters

Texas A&M University completed excavations at the Gault site (41BL323) in Bell County, Texas, in the spring season of 2000. Located at the head of Buttermilk Creek, past inhabitants have enjoyed perennial springs and a variety of natural resources available in the immediate area, including high quality chert from the Balcones Escarpment of the Edwards Plateau. Chipped stone material diagnostic of the Clovis period was recovered during the TAMU block excavation, informally referred to as the "Lindsey Pit," from clay deposits approximately 35 cm thick. Natural agents that may have impacted contextual integrity of the Clovis cultural deposits include stream action, pedoturbation, and bioturbation. Artifact spatial analyses examined long axis orientations and artifact degree of dip to identify non-random patterns that would result from stream action. Vertical and horizontal relationships of refitting artifacts were examined to evaluate post-depositional displacement.

Orientations of chipped stone artifact long axes and inclination were found to be statistically random, with minor patterns that reflect the paleotopography. Thirty-three groups of refitting artifacts were identified, none of which contained elements recovered from deposits more recent than the Clovis clays. Five groups have elements that appear to come from both of the Clovis clay deposits, indicating a small degree of vertical displacement. The results of this research indicate the clays bearing Clovis materials retained a high degree of integrity such that the spatial patterns preserved in the archaeological record at this location are the result of cultural activities and not natural processes. Though time-consuming in the field and laboratory, additional fine-grained analyses such as artifact orientation and refit studies provide separate lines of evidence to account for natural processes that may have acted to obscure the original patterns of the archaeological record, and our understanding of past human cultures.

DEDICATION

This research is dedicated to my parents, family, friends, and colleagues who have encouraged me throughout this work to dig deeper and pursue the next level.

ACKNOWLEDGEMENTS

I want to thank Dr. Waters and Dr. Shafer for the field experience at the Gault site and their ongoing mentorship. I also thank Dr. Waters for providing the opportunity to conduct this geoarchaeological research. For his geomorphic expertise and contributions as the outside committee member, I thank Dr. Tchakerian.

None of this would be possible without the hard work of the Texas A&M University 2000 and 2001 field school participants. Special thanks are given to Charlotte D. Pevny for managing the subsequent data and notes associated with the cultural material that was recorded, as well as the undergraduate students who participated in Gault site post-excavation research. Ian Buvit was the primary orientation data recorder during the field excavation and maintained meticulous notes for use in the artifact orientation analyses. Dr. David Carlson provided expert guidance through the orientation data analyses. Rose diagrams were created using Dr. Todd Thompson's Rose© software that is generously made available to students via the internet.

The refit study required time and space, which can be scarce in any archaeological laboratory. The first and second sets of the refit study were conducted in laboratory space that was made available by Dr. Waters. The third set was completed in Dr. Shafer's laboratory. I am grateful to both for making space and their patience during the course of the study. Two undergraduate students assisted with looking for refits, and several graduate researchers identified refit groups while working on the

Gault assemblage in their separate technological studies, including Charlotte Pevny, Bill Dickens, Scott Minchak, and Damon Burden.

The majority of artifact photographs were artfully completed by Charlotte Pevny. Jason Barrett initially digitized stratigraphic profiles from the Gault TAMU excavations. Several colleagues provided additional Autocad support during my subsequent work with Gault profiles, including J. Bryan Mason, Michael Crow, Scott Minchak, and Guy DellaValle. Graduate Student Advisor Milissa Kennedy deserves special mention for her assistance with essential paperwork and acting as a general point of contact after I moved from College Station.

As director of the Center for Ecological Archaeology (CEA), Dr. Altson Thoms initially welcomed me into the Anthropology Department and accepted my application for employment. I thank Dr. Thoms and Ms. Patricia Clabaugh for the outstanding experience working with the CEA in the field, laboratory, and with technical report production. Sincere thanks are also given to colleagues, archaeologists and friends, including Hope Leininger, Christy and Jim Pritchard, and Andi Stahman for stimulating discussion and sharing of ideas. I also thank Bill Foley, Jr. for reading the manuscript and providing comments. Finally, thanks to my mother and father for their encouragement and support.

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CHAPTER I

INTRODUCTION: THE IMPORTANCE OF RESEARCH

Archaeologists today are concerned with much more than the artifact. To create a fuller picture of past human behavior, researchers look beyond the artifact to the artifact in its context. A much better understanding of past human behaviors can be gained from the fragmented archaeological record when the human aspects are considered as participants in an ecological system. Climate, environment, and geomorphic landscape compose the backdrop for understanding past human lifeways (Butzer 1982).

Context refers to the spatial patterns of artifacts and features that compose an archaeological deposit. The material culture of the archaeological record is considered to be in situ, or in primary context, if the patterns and spatial associations are the reflection of human behavior.

Archaeology and the earth sciences are inherently tied. Once cultural artifacts and features become part of the archaeological record, whether resting on the surface or buried, they become particles of the sedimentary matrix and therefore subject to the influences of same natural processes (Butzer 1982; Hassan 1985; Isaac 1967; Schiffer 1976, 1987; Shackley 1978; Shipman 1981; Villa 1982; Waters 1992).

This thesis follows the style of *American Antiquity*.

This inherent relationship can be recognized historically during the study of human prehistory. At any juncture where a site has the potential to rewrite current models, geologists become the default referees responsible for verifying ages of the deposits and their depositional environments. In 1858 human antiquity gained acceptance after the archaeological finds at Brixham Cave, England, could be verified by a geological group that included Charles Lyell (Rapp and Gifford 1985:4; Rapp and Hill 1998:5). In the New World, evidence for humans living during glacial times wasn't accepted until 1927 when the Folsom site in New Mexico was confirmed to be geologically intact (Rapp and Gifford 1985:13; Rapp and Hill 1998:11; Waters 1992:8; Willey and Sabloff 1993:141). Not until the last half of the twentieth century has the concern for context moved beyond the level of implicit application into the mainstream of archaeological methodology (Hester et al. 1997). In the 1970s geoarchaeology emerged as a professional sub-discipline of archaeology aimed toward applying geologic principles to achieve more comprehensive insights to the past cultural behaviors that are preserved in the archaeological record (Butzer 1982; Schiffer 1987; Waters 1992).

Contextual archaeology, as outlined by Butzer (1982), requires a multidisciplinary approach to the research design, calling for archaeologists to incorporate studies of the non-cultural aspects of a site in order to expand our understanding of the cultural groups gained from knowledge of the environment in which they lived. Contextual archaeology applies a systems model that is divided into two general categories, cultural and non-cultural, which are divided into four components. The cultural component is represented by artifacts and features. The non-cultural aspect includes biological (flora and fauna) and non-biological (physical landscape) components. Each of these provides proxy data for reconstructing the fourth non-cultural component, climate. The sum of these cultural and non-cultural facets is the ecosystem (Butzer 1982).

The basis for understanding this paradigm is recognizing that the constituents of the ecosystem are dynamic, interacting, and striving for equilibrium. Archaeologists study the human adaptations within a particular environment, and look to understand reasons behind change in the cultural process. Change may occur as a result of disequilibrium within the cultural component either within groups or between groups, and between one or more of the non-cultural components. Archaeobotanists, zooarchaeologists, and geoarchaeologists provide specific expertise for examining non-cultural subsystems with the goal of answering archaeological questions (Waters 1992:4-5).

Several authored and edited texts covering the subject of geoarchaeology are now available. Each one offers a slightly different definition for the scope of contemporary geoarchaeology (Goldberg et al. 2006; Rapp and Gifford 1984; Rapp and Hill 1998; Stein and Farrand 2001; Waters 1992). However all agree on the fundamental objectives: to reconstruct the past physical landscape and depositional environment for artifact-bearing deposits, examine the natural processes that result in preservation and destruction of the original patterns of cultural behaviors, construct the absolute and relative timeline of the sedimentary and archaeosedimentary deposits, and reconstruct the changes in climate that are represented in the "dirt".

Justification for This Research

This research is a geoarchaeological investigation of the TAMU 2000 excavation area at the Gault site (41BL323) - a stratified, multi-component prehistoric site in central Texas. There are two primary goals. The first is to reconstruct the landscape and depositional environments reflected in the stratigraphic record. The second is to evaluate the contextual integrity of those deposits by examining the natural processes that culminated in the burial and preservation of deposits bearing Clovis materials.

Archaeologists concerned with drawing an accurate picture of past human behaviors from the archaeological record will first consider the cultural and natural processes that may have distorted the original patterns of artifacts and features left in primary context. Disturbance may have occurred at the time artifacts left the human hands that used them, when the artifacts were exposed on the ground surface, or as sediment buried the location. The risk for disturbance continued after burial, with soil developing processes that involve chemical and physical changes, activity by burrowing creatures, and geomorphic processes. It is possible to undertake such an investigation however because the disturbing processes operate under the law of uniformity for geologic processes, which states that those processes active in the present are also the processes at work in the past and that the results are observable and predictable.

The significance of Clovis archaeology has maintained momentum since the E.B. Howard published his first excavations near Clovis, New Mexico, in the 1930s (Boldurian and Cotter 1999). The body of current research is vast and includes investigations of new sites (e.g., Ferring 1995), the review of data or collections from previous excavations (e.g., Boldurian and Cotter 1999), as well as regional syntheses (e.g., Holliday 1997; see also Bonnichsen et al. 2006; Bonnichsen and Steele 1994; Bonnichsen and Turnmire 1991, 1999; Soffer and Praslov 1993; West 1996).

Clovis as Early Americans

Paleoindian research through the 1960s supported the original model for Clovis as the colonists of the New World: small bands of highly mobile and successful mammoth hunters who traveled across the Bering Strait during the last glacial period, continuing south to the continental United States through an ice-free corridor, and finally exploding onto the fertile hunting grounds of the Great Plains (Boldurian and Cotter 1999:26-27). With improved methods and technology in archaeology and related sub-disciplines such as paleobotany and zooarchaeology, the more recent evidence indicates that Clovis people were more generalized hunter-gatherers who likely adapted regionally to specifically available resources. Radiocarbon dates bracket the Clovis occupation in the Great Plains and Southwest between 11,500 and 10,900 years B.P. (Haynes 1993). Waters and Stafford (2007) re-examined radiocarbon samples from Clovis sites with secure geologic context. Their work refined the Clovis time period to between 11,050 and 10,800 years B.P.

Clovis points have been reported from coast to coast in the United States, anywhere south of the periglacial boundary that existed at the southern border of Canada (Meltzer 1993). The majority of these reports are isolated finds from archaeological surveys or in collection inventories provided by prehistory enthusiasts. Either way, their widespread presence prompted archaeologists to consider, and reconsider, the possibility of a continent-wide adaptation (Meltzer 1993). Similar to our pursuit of understanding who Clovis people may have become, the question of Clovis origins or the case for earlier human occupations in the New World remains tentative and unsolved. Archaeologists must continue to search for insights into cultural chronologies via radiocarbon dating of in situ materials and stratified occupations whenever possible (Waters and Stafford 2007).

Stratified sites are rare (Haynes 1993:219), considering nationwide reports of isolated finds and "whenever possible" must be recognized as a significant limitation of the extant research – many Clovis sites in the extant research are fortuitous and not the result of a systematically designed survey that applies methods appropriate for identifying late Pleistocene deposits where cultural materials may be preserved . Many of the known sites are located in the Great Plains and Southwest regions of the United States and are associated with extinct large mammal bones. This is no surprise when we review the history of Paleoindian archaeology – many sites were revealed during droughts that facilitated erosional conditions and exposed late Pleistocene sediments bearing highly visible bones of mammoths and bison. These are the kill and scavenge sites that provided the foundation for the traditional Clovis model as mammoth hunters who were so successful they hunted the mammoth into extinction (Meltzer 1993).

Archaeologists strive to elucidate cultural associations between groups through assemblage comparisons and technological analyses of diagnostic artifact characteristics, and in the case of Clovis the primary diagnostic is its fluted point. The Clovis assemblage also includes blades, large flake tools, sidescrapers, and endscrapers which are technologically uniform despite the different environmental contexts in which they are found. Dating to the late Pleistocene, Clovis people lived in an environment unlike any known today. Ice Age megafauna such as camel, horse, giant sloth, and mammoth lived in North America. The late Pleistocene has no modern analog for climate or environments. Similarly, there isn't a clear analog for Clovis people among today's hunter-gatherer groups. In our modern world, hunting and gathering societies no longer have the option to move into unoccupied territories (Kelly and Todd 1988).

The environmental changes of the Late Pleistocene-Holocene transition would have had severe repercussions for the archaeological record at that time, destroying earlier sites and making their discovery even more challenging. Reconstructing the depositional history of sedimentary sequences is crucial especially at sites bearing Clovis cultural material. If the previously existing sediments were removed, the archaeology was removed with it and lack of evidence for humans before Clovis peoples is a result of natural processes and not a reflection of behavioral activity.

Clovis as Texans

Texas offers researchers unique opportunities for Paleoindian studies as the geographic meeting of the eastern woodlands, northern plains, and western desert regions in the United States. In each cardinal direction, central Texas offers transitional environments and providing a wider range of resources than would be found in a more homogenous environment. The Edwards Plateau in marks the southern boundary of the mid-continental Great Plains region and the sub-region of the Southern High Plains of northwest Texas and eastern New Mexico, where several significant Paleoindian sites have been recorded since Clovis was established (Bousman et al. 2004; Haynes 1993). The eastern edge of the Edwards Plateau is characterized as an ecotonal environment where valuable resources could be found, such as stream valleys with abundant resources for food and shelter and limestone outcrops of the high-quality Edwards chert (Collins 2002).

This is where the Gault site is found. This open-air site is situated in the ecotone between the Edwards Plateau and Post Oak Savannah (Hester et al. 1998). Located at the headwaters of Buttermilk Creek, perennial springs and varied resources have attracted human inhabitants to the area for more than 10,000 years. Alluvial processes are the primary agent responsible for the stratified cultural deposits, although deposition over time has been differential so that the earliest deposits are thicker than the more recent deposits. Additionally, the last 100 years has witnessed non-scientific excavations by persons collecting Archaic period projectile points that could be found in the upper deposits (Hester 1998). Fortunately for Paleoindian researchers, the deposits beneath the extensive burned rock middens containing these point types went relatively untouched. Amidst the debate of who were the First Americans, the Gault site offers a unique research opportunity as one of the few known quarry and residential sites to further our understanding of these early inhabitants of North America.

Objectives

In the spring of 2000, students from Texas A&M University, College Station, completed field excavations at the Gault site under the direction of Drs. Harry Shafer and Michael Waters, in cooperation with Dr. Michael Collins of the University of Texas.

A multi-component archaeological resource, Gault proved to contain an exceptional Clovis component preserved in fine-grained sediments at the lowest stratigraphic position, just above bedrock.

This research was undertaken to provide the foundation for spatial analyses of the significant archaeological record that was recorded at this location. My research objectives were to:

(1) construct the temporal and spatial frame for the cultural layers of the TAMU excavation block.

(2) examine the extent to which natural agencies may have influenced the composition of the cultural material in the Clovis-age deposits at the time of their deposition, as the artifacts were buried by sediment, and after they were buried.

This first objective follows contextual archaeological theory by placing the cultural deposits in geochronologic sequence and determining the site's location on the geomorphic landscape (Waters 1992:11-12). The second objective evaluates the extent to which natural processes may have altered the behavioral patterns originally left to become part of the archaeological record. To obtain these objectives, I pursued two research components.

The first component was to define the stratigraphy of the excavation area. From the stratigraphic record the depositional history of the TAMU block excavation could be reconstructed. Sediment and soil attributes were described and used to infer the site's position on the geomorphic landscape.

The second component comprised a taphonomical study of the Clovis component. Artifact orientations were examined to identify patterns that would reflect the influence of natural agencies during artifact deposition, while artifacts were exposed on the surface, and as artifacts were buried with sediment. A refit study of the chipped stone material recovered from the Clovis deposits was completed to identify patterns of artifact vertical movement. Refitted artifacts reflect contemporaneity – a shared moment of time between two conjoining pieces (Hofman 1992a; Villa 1982). By looking at the horizontal spatial relationships of refitted artifacts it is possible to identify contemporary activity areas. Vertical separation between refitting artifacts is an excellent method for identifying post-depositional movement. The absence of conjoined pieces across stratigraphic boundaries is an indication of better contextual integrity.

CHAPTER II

SITE LOCATION AND SETTING

Site Location

The Gault site is located in central Texas at the border of Bell and Williamson counties in the upper reaches of Buttermilk Creek, approximately 72 km (45 miles) north of the capital city Austin (see Figure 1). This is the eastern margin of the Edwards Plateau called the Lampasas Cut Plain, where the Balcones Escarpment marks the southern and eastern extents of the United States Southern Great Plains. The Balcones Escarpment is a fault zone that was active during the Tertiary period resulting in uplifted lower Cretaceous limestone sitting adjacent to upper Cretaceous marls and soft limestone . The soft upper Cretaceous deposits were the alluvial source material for the stream valleys that dissected the eastern edge of the plateau until were eroded to the more resistant limestone that is found on upland surfaces today. Edwards chert, an important prehistoric resource for tools, outcrops in tabular and nodular forms. The uplands today are covered by thin soils with steep stony slopes. However just east of the escarpment is the Blackland Prairie, the western-most sub-region of the Gulf Coastal Plain. In this region soils are deep and underlain by upper Cretaceous marls and soft limestone (Huckabee et al. 1977; Ellis et al. 1995; Sellards et al. 1932).

Buttermilk Creek is a first order stream with a catchement basin measuring 43 km^2 (Gibson 1997). Its sinuosity measures 1.26 with a gradient of 8.5 m/km; it is characterized as a braided/meandering stream type that is underfit to its stream valley by a ratio of 1:3. It is incised into the Comanche Peak Limestone of the Fredericksburg Group (Gibson 1997). Edwards Limestone, also of the Fredericksburg Group, is the upland surface formation (Barnes 1979).

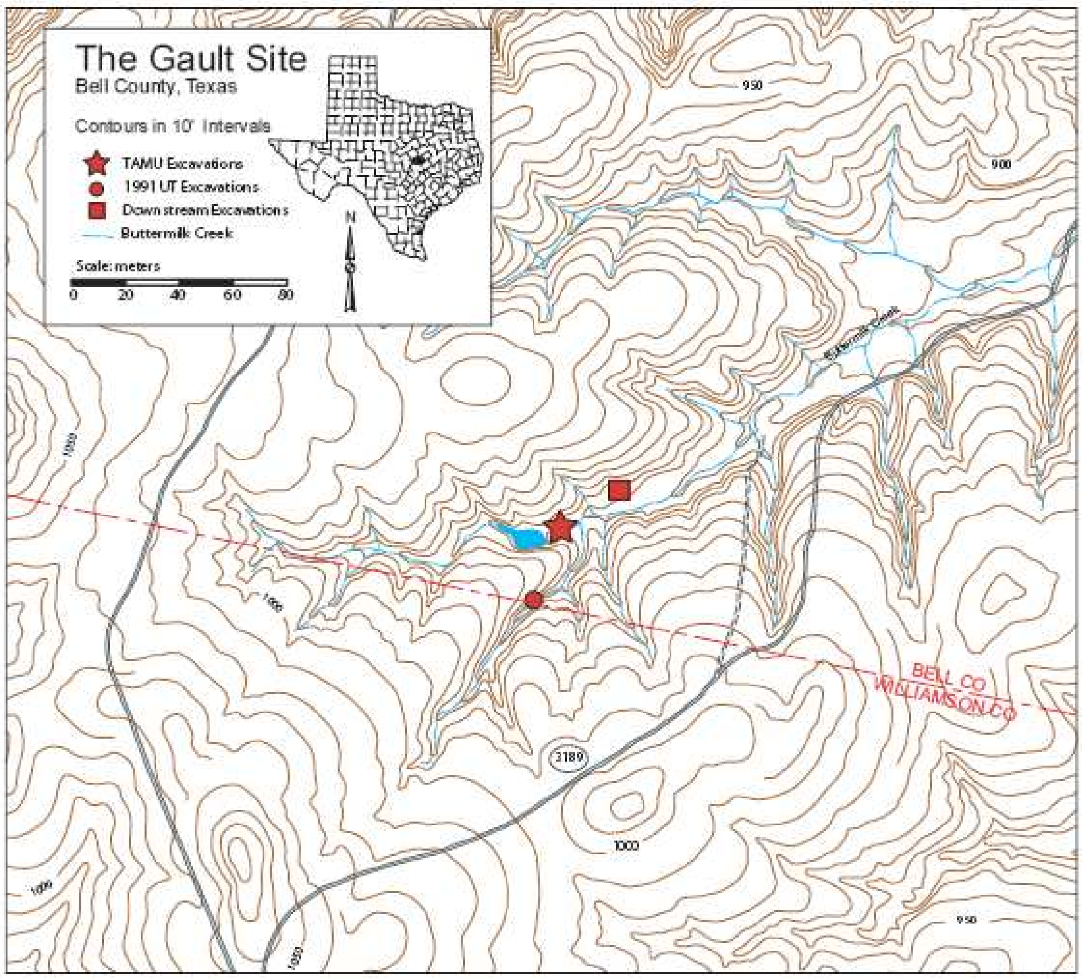


Figure 1. Location of the Gault site in Bell County, Texas (Minchak 2007).

Site Setting

Climate

The climate is subtropical, humid with an annual precipitation average of 86cm (34in) (Larkin and Bomar 1983). The highest rainfall values occur in spring and fall when seasonal weather patterns are most active, resulting in river scours and mudflows (Caran and Baker 1986). Temperatures range from July high average of 36 degrees Celsius (96 degrees Fahrenheit) to January low average of 2 degrees Celsius (36 degrees Fahrenheit). The average growing season (frost-free days) is 260 days per year, with a mild winter season period interspersed with brief cold spells in December and January (Connor and Odintz 2006; Huckabee et al. 1977).

Flora and Fauna

Shallow soils of the uplands support tall grasses and oak, juniper, pine, and mesquite trees; current land use involves ranching (cattle, goat, sheep), hardwood and pine production, and limestone quarry activity. Deep soils on the prairie support mixed grasses, and invading species of trees such as oak and mesquite. Farming is the dominant use of land east of the escarpment (Huckabee et al. 1977).

The fauna in this area reflects the transitional environment that defines the Balconian biotic province (Blair 1950; Riskind and Diamond 1986); species common to adjacent biotic provinces reach the extent of their habitats here. The western Chihuahuan species are at their easternmost extent in the xeric uplands of the Edwards Plateau, while the Austroriparian species are living at the westernmost extent of the Texan province in mesic environments that are found in broad stream valleys just east of the escarpment. Species characteristic of the Tamaulipan and Kansan provinces are also found to a lesser degree. Mammalian species include deer, bobcat, mountain lion, coyote, gopher, squirrel badger, skunk, mink, weasel, raccoon, bat, armadillo, mole, possum, rat, and mouse. Other terrestrial vertebrates include terrapins, lizards, snakes, frogs, toads, and salamanders. Migratory birds and waterfowl are common; as well as numerous freshwater fish species including gar, carp, catfish, bass, crappie, drum, and shad (Riskind and Diamond 1986; Toomey et al. 1993).

Late Quaternary Environment

The environment of central Texas when Clovis groups were present was very different than what exists today. Without a modern analogy, earth scientists use a variety of proxy data sources to infer past climates and reconstruct environments. The indirect nature of proxy sources introduces increased potential for error; however, we can increase the accuracy of reconstructions by using multiple lines of evidence from well-preserved data (Bousman 1998; Ellis et al. 1995). Current paleoenvironmental data sources for central Texas include pollen from peat bogs (Bryant and Holloway 1984; Bousman 1998), botanicals and faunal remains from caves and rockshelters (Lundelius 1986; Toomey et al. 1993), and stable carbon isotopes from alluvial sequences (Humphrey and Ferring 1994; Nordt et al. 1994). The stratigraphic record preserved in alluvial settings is also a valuable source for paleoenvironment reconstructions (Butzer 1982; Waters 1992). Two studies are available that are relevant to the Gault site stratigraphy (Gibson 1997; Nordt 1992, 1995) and are discussed in detail in Chapter III. The following summary of central Texas paleoenvironment is derived from Bryant and

Shafer (1977), Toomey et al. (1993), Collins (1995), and Bousman (1998), with additional information where indicated.

During the full glaciation period (22,500 to 14,000 B.P.) the climate was cooler and more humid than the modern climate. Central Texas was heavily forested with deciduous trees, and supported now-extinct large mammals. Other faunal remains are related to fauna now living in cooler and wetter environments to the north and east, which indicates reduced seasonality. Pollen records from Patschke and Boriak Bogs in east-central TX indicate mixed grassland and parkland with northern species, spruce, and birch. Pollen from Friesenhahn Cave (near the Balcones escarpment) indicates open savanna with mixed grass understory, and spruce along valley bottoms. Sediments from Hall's Cave are "dominated by red clays, with few coarse limestone fragments, suggesting that limestone upland source areas were covered by deep red soils" (Toomey et al.1993: 305) supports the findings of burrowing animals such as prairie dogs, pocket gophers, moles, and other burrowers in cave faunas.

The late Pleistocene (14,000 to 10,000 B.P.) is characterized as a warmer and drier climate that supported a mosaic of open to closed plant communities. These grasslands, oak woodlands, and pine forests exemplify the diversity supported in a more temperate environment. Pollen evidence reflects continued warming and drying with progressive loss of mesic vegetation and allowed the firm establishment of grasslands and oak-hickory savannahs that are present today (Bryant and Holloway 1984). Cave faunas indicate a rapid increase in summer temperatures from 15,000 to 13,000 yr B.P. The masked shrew , present when summer temperatures are cooler, disappears from

Hall's Cave record by ca. 14,500 yr B.P. while the cotton rat, common where summer temperatures are warmer, appears ca. 12,500 yr B.P. Hall's Cave also provides evidence that effective moisture decreased and then increased again from 14,000-10,500 yr B.P., initial decrease reflected with the disappearance of the bog lemming. From ca. 12,500 to 10,500 yr B.P. the desert shrew increases in abundance compared to the least shrew – which requires moister environments and now lives east of the escarpment – then decreases in abundance suggesting a more mesic environment. The presence of pocket gopher and prairie dog reflect mixed-grasses in central region of Edward's Plateau. Burrowing animals and red clay sediments in caves indicate that deeply weathered reddish soils were still covering upland surfaces. These data support Haynes' (1991) proposal of a Clovis-age drought, supported by the stratigraphic and geomorphic evidence at the Murray Springs site in southeastern Arizona. Many large mammals were extinct at the end of the Pleistocene, marking the "gradual reorganization of extant taxa to a more modern aspect" (Toomey et al. 1993: 308).

The early through middle Holocene environment (10,000 - 5,000 B.P.) continued the drying pattern from the Late Pleistocene. Hall's Cave microvertebrate taxa provide evidence of "extirpation" of those requiring higher moisture requirements, and an increased number of species that tolerate drier conditions. Pollen records indicate increasing xeric conditions/decreasing effective moisture (Bonfire Shelter, Hinds Cave, Boriack Bog). Pocket gophers, prairie dogs, and badgers are still found in cave faunas, thus soil mantles were still present and vegetation probably consisted of tall and short grasses. Cave sediments change however, after 8000 B.P. with increased vertical accretion apparent at Hall's Cave, color changes to dark reddish brown, a decrease in clay content and an increase in transported limestone clasts. Conditions were such that soil mantles were eroding, becoming darker, thinner, and stonier. Further, prairie dogs are no longer present after this time (Toomey et al. 1993: 308).

The middle to late Holocene (5000-2500 B.P.) is proposed to be the driest period experienced in the last 20,000 years, based on disappearance of taxa with high moisture requirements from Hall's Cave. Pollen records reflect continued warmer and drier conditions through to present time with grasslands and the oak-hickory savannahs becoming firmly established. Bryant and Holloway (1985) report evidence of a brief return to mesic conditions at around 2500 B.P. from sources in southwest and west Texas. Hall's Cave shows more effective moisture than present with the return of the woodland vole and eastern pipestrelle bat and an increase in least shrew versus the desert shrew. Upland soil mantles have disappeared, leaving thin stony soils. Toomey et al. (1993) conclude that the modern xeric climate is present in central Texas at 1000 B.P. Bog pollen evidence indicates decreased moisture but still a mesic environment during this time period (Collins 1995; Bousman 1998).

To summarize, multidisciplinary studies agree on large scale trends of environmental change, however disagreement between studies becomes apparent at smaller scales (Ellis et al. 1995). Conflicting models result from differential process-response patterns. The critical threshold for change will be different for each kind of data source. Equifinality introduces a second source for conflict – data sources can have the same result (e.g., extinction) but for different reasons. Plant and animal communities have changed in structure so that a modern analog for Pleistocene and late Pleistocene environments does not exist. Species that are disharmonious in the modern environment can be found together in the more temperate environment of the Late Pleistocene. Indirect paleoenvironmental data shows that the last 20,000 years in central Texas have been dynamic, with alternating warmer/drier and cooler/wetter conditions. Pollen and stable isotope evidence reflects a forested landscape during full glacial time, a parkland-woodland environment during the late Pleistocene, and finally the grassland-parkland environment known today (Bousman 1998; Collins 1995; Ellis et al. 1995; Nordt et al. 1994; Toomey et al. 1993).

CHAPTER III

STRATIGRAPHY

Introduction

Stratigraphy refers to the natural and cultural layers of materials that form an archaeological site. Layers are defined by shared characteristics, most commonly derived from lithology, pedology, or chronology. By viewing the layers in this geologic framework, we are able to organize the excavated material in space and time (Waters 1992). At the TAMU excavation block, stratigraphic units were organized by lithology and, in the absence of datable organic material, put into relative chronology. Positive correlations with regional geoarchaeological investigations by Gibson (1997) and Nordt (1992, 1995) supplement the Gault TAMU block excavation stratigraphy with relative and absolute ages.

Methods

An area measuring 5 x 7 meters was excavated during the Spring 2000 fieldwork (see Figure 2); additional trench and unit excavations were examined along the east 989 transect, southeast of the 2000 excavation area, the following year. Stratigraphic sections are reported in this section for the east 982 and Trench 2 profiles, which capture the sequence of lithostratigraphic units at this location. The stratigraphic record was recorded by hand during field excavations and subsequently digitized using Autocad 2000 and 2002 software. Dr. M. R. Waters characterized the sediment and soil attributes following Soil Survey Staff standards (1981).

Results

Seven lithostratigraphic units and one buried soil were identified, and a second buried soil was confirmed during micromorphological analyses (Luchsinger 2002). Two facies are evident in the east -982, -983,-985 and Trench 2 profiles: alluvial deposits associated with overbank and floodplain formation, which interfinger with colluvial deposits in the southern area of the excavation (see Figures 3 and 4). General unit descriptions are reported in Table 1.

The basal unit of the excavation area consists of limestone bedrock. This bedrock bench is unconformably overlain by unit 1 in the southern excavation units and by unit 2 in the central and northern excavation units. Unit 1 consists of framework-supported subrounded, irregular limestone cobbles that average 5-6 cm in diameter but measure up to 25 x 15 cm. It meets with unit 2, a framework-supported gravel that consists of small granules to cobbles (up to 30 x 15 x 15 cm). These cobbles are subangular to subrounded limestone with chert nodules. The lateral contact between units 1 and 2 indicates these are coeval.

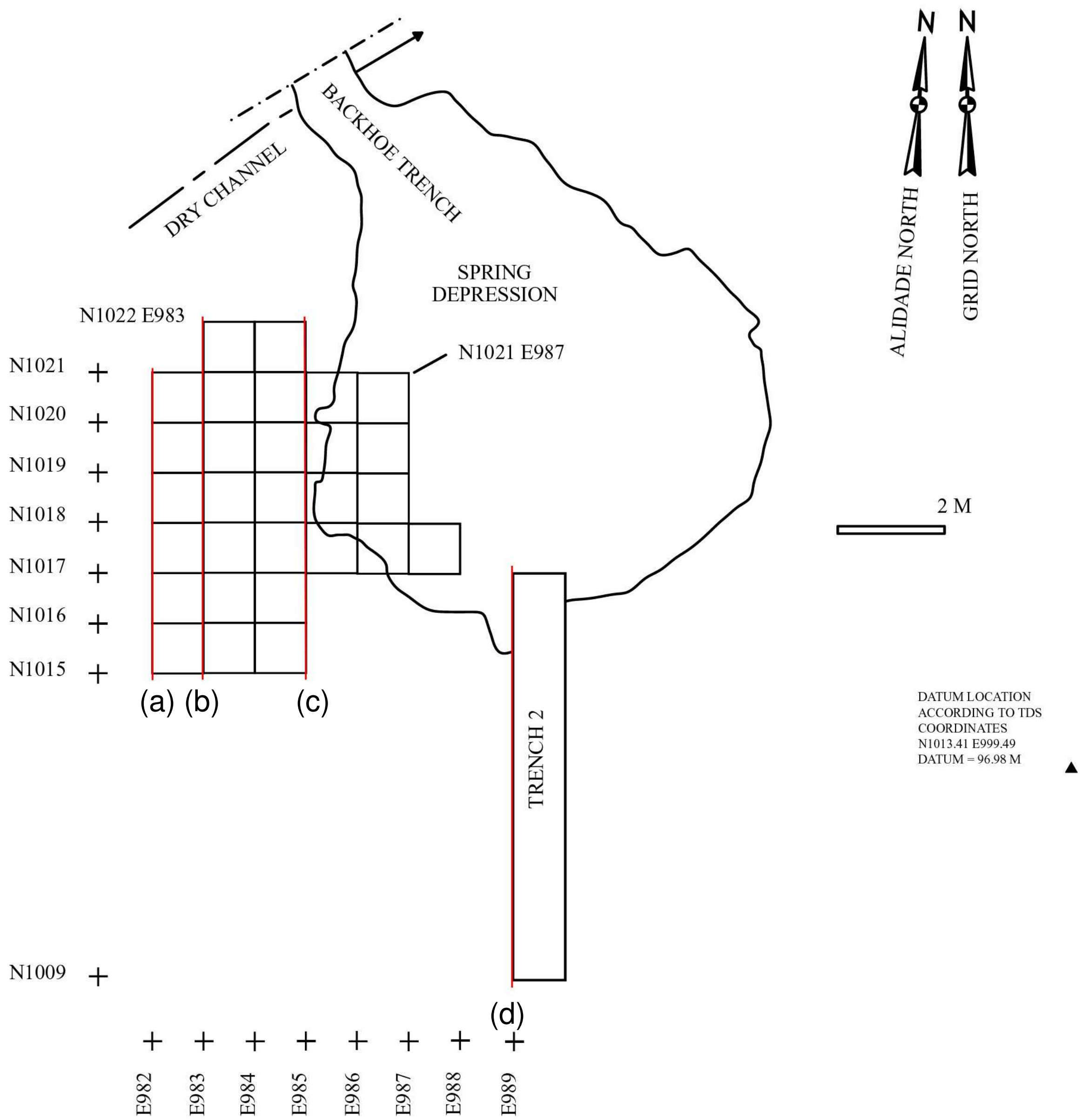


Figure 2. TAMU excavation area and trench 2 relative to the spring depression, often referred to as the "Lindsey Pit." (Profile sections depicted in Figures 3 are labeled (a) east 982 transect, (b) east 983 transect, and (c) east 985 transect. Figure 4 depicts (d) Trench 2 transect).

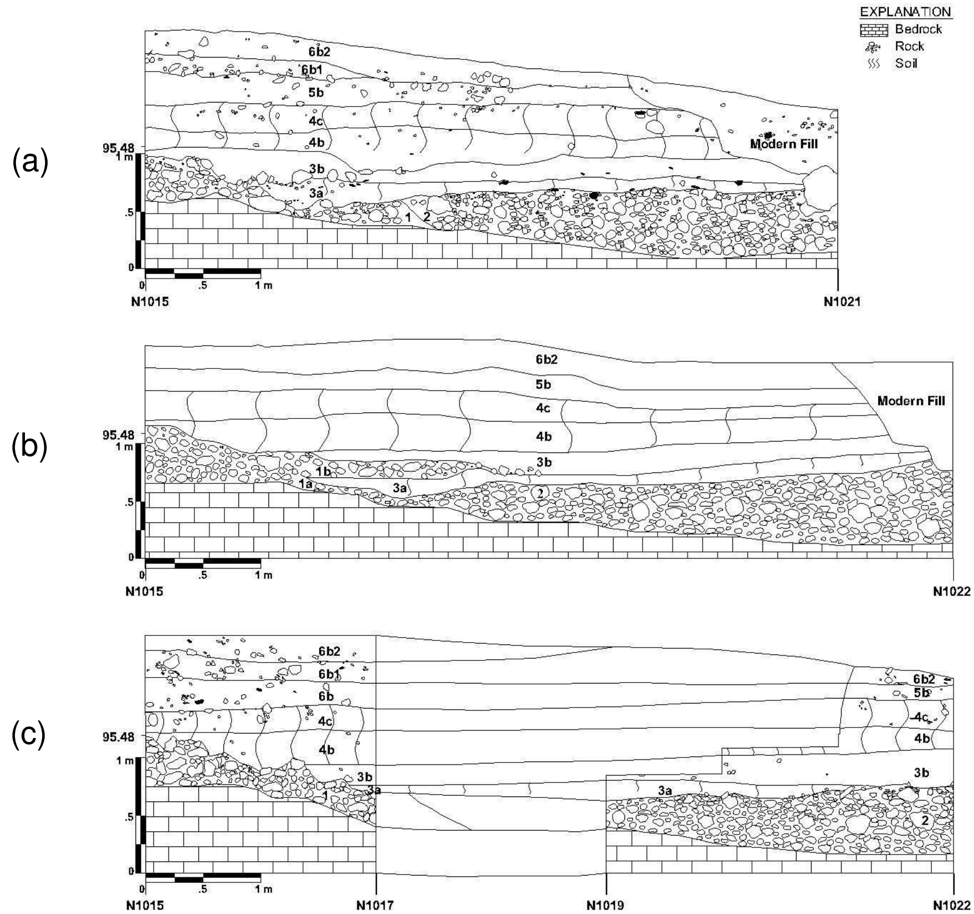


Figure 3. TAMU excavation area east-transect stratigraphic profiles: (a) east 982, (b) east 983 (reconstructed), and (c) east 985.

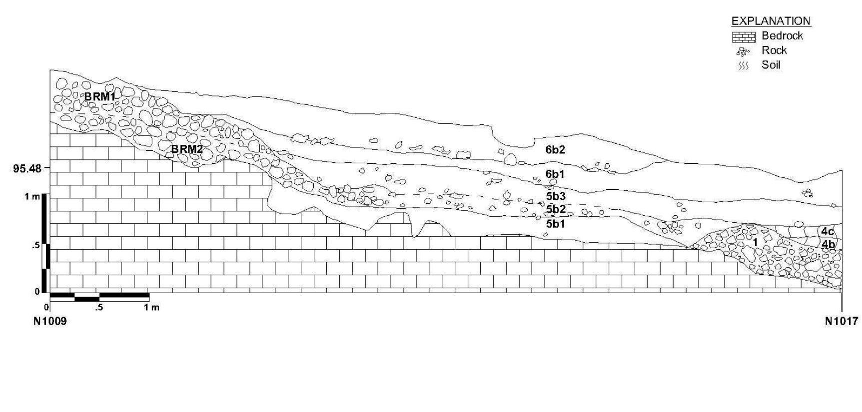


Figure 4. Trench 2 (east 989 transect) stratigraphic profile.

Table 1. Lithostratigraphic Unit Descriptions.

Unit	Color (wet samples)	Texture	Description	Facies
1	Light brownish gray (2.5Y6/2)	Limestone cobbles, clay	Limestone gravel, iron mottles, root voids and roots	Colluvium
2	Yellowish brown (10YR5/4)	Limestone cobbles, sandy clay	Cherty gravel, mottled iron and manganese oxides, roots	Alluvium (channel)
3a	Light to dark brownish gray (10YR6/2 to 4/2)	Clay	Calcium carbonate nodules (0.5-3mm), iron mottles, slickensides, artifacts coated on both sides	Alluvium (point bar / floodplain)
3b	Dark grayish brown (10YR4/2)	Clay	Calcium carbonate nodules (2-5mm), coatings thickest on underside of artifacts, iron mottled root coatings, roots	Alluvium (point bar / floodplain)
4b	Light brownish gray (10YR6/2)	Clay	Few calcium carbonate nodules (2-3mm), manganese and iron stains on root channels, roots and root voids	Alluvium (floodplain)
4c	Brown to dark grayish brown (10YR5/3 to 4/2)	Clay	Abundant calcium carbonate nodules (1-10cm), roots	Alluvium (floodplain)
5b	Brown (10YR5/3)	Silty clay	Abundant calcium carbonate nodules (2-5cm), undersides of flakes and rock are coated, artifacts and colluvial rocks scattered throughout, yellow iron mottles, few snails	Alluvium (floodplain)
6b1	Dark grayish brown (10YR4/2)	Clay	Abundant whole and fragmented *Rabdotis* shells, subrounded colluvial gravel, fire-cracked rock, and artifacts throughout	Alluvium (floodplain)
6b2	Very dark grayish brown (10YR3/2)	Silty clay	Calcium carbonate nodules (1-3mm), fragmented *Rabdotis* shells, colluvial gravel and artifacts	Alluvium (floodplain)
7b	Black (10YR2/1)	Clay	Fragmented snail (*Rabdotis*) shells, roots	Floodplain

Unit 2 is unconformably overlain by unit 3a, a lens-shaped clay deposit that is thickest at its southern shape and thins to the north, in the direction of the current stream channel. Unit 3a is also the oldest cultural layer in the profile, where chipped stone artifacts, including diagnostic Clovis fluted points, were recovered from a the matrix of light to dark brownish gray clay. Slickensides are found on wedge faces and ped faces. Calcium carbonate nodules range from 0.5 to 3 cm. Chipped stone artifacts have coatings on top surfaces, bottom surfaces, or both. Unit 3a pinches out as it meets unit 1 gravels, indicating coeval deposition. It is unconformably overlain by unit 3b, although in some places the contact was difficult to discern. Unit 3b is a second artifact-rich layer with a dark grayish brown clay matrix. Calcium carbonate nodules are common (ca. 20 percent) in this unit, round to irregular and slightly smaller (2-5 mm diameter) than those encountered in the underlying unit. Chipped stone artifacts have calcium carbonate coating that is thickest on the underside, increasing in concentration when nearer to the contact with unit 3a. A light calcium carbonate coating is commonly found on the top of artifacts.

An abrupt contact separates unit 3b from the overlying unit 4b. The lower portion of unit 4b consists of massive clay that is brown (10 YR 5/3d) to light brownish gray (10YR 6/2 w), slightly hard and sticky. Samples ranged from slightly to strongly effervescent with few, soft, rounded to irregular calcium carbonate nodules 2-3 mm in size. Redoximorphic features are very common and distinct. Manganese and iron stains follow root channels. Few stones 1-8 cm in diameter are dispersed throughout, as well as roots and root holes. Faint structure is characterized as weak, subangular blocky (fine to medium). This lower portion of unit 4b grades upward and conformably to a clear buried soil. The upper portion of 4b is characterized as Bk2 soil, a hard, very sticky, plastic clay characterized as light brownish gray (10 YR 6/2d) to brown (10 YR 5/3w) with moderate, fine subangular blocky structure. Samples are strongly effervescent with abundant 1-10 cm calcium carbonate nodules that are irregularly shaped, soft, and formed along ped faces. Fine iron stains are few to common, faint, and follow root tracks. The upper boundary of unit 4c, the upper portion of the buried soil, was initially thought to be transitional however the iron stains could not be traced into the overlying unit. Unit 4c is characterized as Bk1, the top of the Royalty paleosol.

Unit 4c consists of grayish brown (10 YR 5/2d) to dark grayish brown (10 YR 4/2w) clay that is very sticky and plastic. Soil development appears as medium to coarse subangular blocky structure that is strongly effervescent with 2-5 mm hard, round to irregular calcium carbonate nodules. Smaller nodules are softer; some are 1 mm in diameter. All calcium carbonate nodules occur on ped and fracture faces and are especially common in the lower portion of this unit. Yellowish brown (10 YR 5/4d) iron mottles occur mostly at the top of this unit and are characterized as few to common and fine. An abrupt contact separates unit 4c from the overlying unit.

Unit 5b consists of silty clay that is light brownish gray/brown (10 YR 6/2d – 10 YR 5/3w), slightly hard, sticky, and plastic with strong coarse granular structure. It strongly effervesces with irregular 2-5cm calcium carbonate nodules throughout the unit. Peds are hard to slightly hard. Yellow (10 YR 7/8d) iron oxide mottles are common throughout the unit (10 percent), 2-5 mm, fine distinct, and forming on exteriors of calcium carbonate nodules. Chipped stone artifacts, subangular to subrounded limestone cobbles (8.5 x 6 x 4 cm to 4.5 x 2.5 x 2.5 cm) are found in this matrix-supported unit. They are rare and scattered in the profile and appear to be colluvial inclusions. Few snails, bone fragments, roots and root hairs are also observed.

Unit 6b1 consists of silt to clayey silt characterized as grayish brown/dark grayish brown (10 YR 5/2d – 10 YR 4/2w) that is slightly hard, slightly sticky, plastic, with strong medium granular/crumb structure. It strongly effervesces. The contact with the underlying unit is abrupt. The unit is dominated by mostly fragmentary but also many whole *Rabdotis* shells, colluvial gravels that are subrounded, up to 14 cm long, 2-4 cm rounded to subangular gravels, firecracked rock, and chipped stone artifacts. Unit 6b1 is separated from Unit 6b2 by a distinct contact, however is considered part of the "shell hash" described below.

Unit 6b2, referred to as the "shell hash", consists of silty clay characterized as gray/very dark grayish brown (10 YR 5/1d – 10 YR 3/2w), slightly hard, slightly sticky, plastic, with moderate to coarse subangular blocky structure. It strongly effervesces and includes 1-3mm irregular to rounded hard calcium carbonate nodules.

Unit 7b is a modern, black overbank deposit that is unconformably situated above unit 6b2. It consists of clayey silt, very dark gray (10 YR 3/1d), black (10 YR 2/1w), and is characterized as very hard, slightly sticky and plastic, with strong coarse subangular blocky structure. It is very slightly effervescent, with no visible calcium carbonate nodules, along ped faces and small root voids.

Buttermilk Creek and Fort Hood Geoarchaeology

Few studies investigating the Late Quaternary geomorphic history of low order central Texas have been completed. Two geoarchaeological studies are available that (Gibson 1997; Nordt 1992, 1995) provide a chronological framework relevant to the stratigraphy encountered during the TAMU 2000 Gault site excavation. Because Gault materials were not preserved well enough to obtain radiometric dating, these studies are summarized here to better define the Late Quaternary temporal frame and associated environments. Correlations between these investigations and the Gault stratigraphy are then discussed.

Buttermilk Creek

Gibson (1997) conducted a geoarchaeological study of Buttermilk Creek to investigate the geomorphic influence of climate change on a lower-order stream in central Texas, with the objective to develop an archaeological site predictive model along Buttermilk Creek. From approximately 25 cutbank exposures, 5 terraces (T4 to T0, oldest to youngest), 6 alluvial units, 1 buried soil, and 3 surface soils were identified. For this discussion, I've focused on the alluvial unit descriptions.

All alluvial units rested on bedrock except T2, where the Solona alluvium buried the older Roden alluvium. A temporal frame for the Late Quaternary history was constructed using absolute ages provided by two radiocarbon ages obtained from charcoal samples. Alluvial units were correlated with regional stratigraphic studies as a means to more precisely date units. Relative ages were incorporated using diagnostic artifacts from the study area that had been recorded in situ.

The oldest unit is the Lankford alluvium, measuring approximately 7 m in thickness. The Lankford consists of rounded river gravel deposits alternating with overbank clay sediments. No cultural material was observed. This alluvium was assigned a Late Pleistocene age of deposition based on the position of T4 relative to other dated units on the landscape and for the absence of cultural material during this investigation.

The second oldest unit is the Roden alluvium, averaging 3.5 m thick and resting on a bedrock bench 2.5-3.5m above the modern channel. Moderately well-sorted rounded gravels 60 to 70 cm thick compose the basal layer, overlain by 180 to 280 cm of coarse sandy clay loam fining upward to very fine clay loam. A high percentage of secondary calcium carbonate has cemented chert flakes and filaments are most dense in the top of the Roden alluvium. Nodules replace filaments with depth, increasing in size and density but disappearing at the parent material level. The Brown paleosol (Bk1 – Bk2 – BC) caps the Roden and separates it from the overlying Solona alluvium.

The Solona sediments consist of channel and floodplain facies, but can be characterized generally as coarse gravelly sediments when compared to the Roden alluvium. Gibson (1997:52) theorizes the change to coarser sediments is either the result of 1) a change in hydrological regimes, where the Roden alluvium reflects regular flow of Buttermilk Creek and the Solona indicates a change to episodic and flashy flow, or 2) a change in the alluvium source where fine materials have been depleted and coarser sediments are now being eroded.

After a period of erosion and downcutting, the Lim alluvium was deposited. It is topped by a surface soil, which is observed to maximum depth of 230 cm. The unit averaged 4.3 m in thickness, with highly variable facies between the six exposures that were recorded. Resting on a bedrock bench between 0.6 and 2m above the modern channel, the Lim alluvium consists of several sandy strata that may or may not have a thick gravel stratum as well. Bedding is classified as massive, reflecting vertical accretion and, with abrupt boundaries between the coarse-grained deposits, indicates an episodic hydrologic regime. One radiocarbon sample was obtained from an in situ hearth approximately 1.4 m below the terrace surface (3895 +/- 150 B.P. [A-0565; wood charcoal]). This age along with an Ensor projectile point recovered from the surface provides evidence that deposition of the Lim alluvium took place between 5000 and 2300 B.P.

The Eden alluvium forms the next youngest terrace (T1), measured 2.8 to 3.3 m in height from the creek bed. The alternating strata consist of sandy clay loam, silty clay loam, and moderately well-sorted granule to pebble-sized rounded gravels, though without any apparent fining sequences. One radiocarbon sample was obtained from dispersed charcoal fragments (135+/-150 B.P. [A-9563; wood charcoal]). The soil on the surface of T1 extends to a maximum depth of 1.2 m and is defined as a cumulic soil since this surface floods every five to ten years. The beginning age for deposition of the Eden alluvium is estimated at 2300 B.P., relative to abandonment of T2, and is characterized as deposition by sporadic flow reflected in sandy and gravelly strata with no bedding structures.

The Adams alluvium composes the modern floodplain. Recorded at one location though observed at many others, it measured 1.8 m above the modern channel bed and averages 2-3 m in width from the creek bank. This alluvial unit rests on bedrock at the creek level, and comprises a fining upward sequence of rounded river gravels, fine sandy clay loam, and clay loam, with a light sandy lens 3-4 cm thick within the uppermost 40 cm. The surface soil (S1) is characterized as weak and cumulic, developing as the unit aggrades with deposition from a migrating, relatively regular flowing creek with very low flow.

Fort Hood Military Reserve

Nordt (1992, 1995) completed geoarchaeological work at Fort Hood Military Reserve in fulfillment of a contract to develop a temporal and spatial model for buried cultural resources based on the Late Quaternary geologic history of the drainage basins within the Reserve. The stratigraphy of numerous cutbank exposures and backhoe trenches was recorded. Charcoal and bulk humate samples provided radiometric ages. Buttermilk Creek drainage basin is smaller than the smallest basin recorded at Fort Hood, therefore this summary focuses on the results regarding the small drainages. Interpretations of climate and environment by Nordt (1992, 1995) are included here to provide a regional overview.

Five alluvial units were identified within three terrace formations. The oldest unit is the Jackson alluvium. This unit is composed of alternating channel and overbank facies of equal proportions and is assigned a late Pleistocene age based on radiocarbon results from bulk humates (15,230 B.P.). This represents the earliest age bracket for the beginning of a major erosional event that scoured the valley to bedrock that occurred between 15,000 and 11,000 B.P., followed by deposition of the Georgetown alluvium. However, the Georgetown sediments and channel type do not reflect the power that such a result would have required (Nordt 1992:62).

The following unit is the Georgetown alluvium, which comprised fine, well-sorted gravels overlain by massive yellow and gray loams to silty clay loams and is measured 2-5 m thick in the upland basins of this study. The massive overbank sediments exhibit a fining upward sequence to a truncated buried soil. This diagnostic marker horizon has been termed the Royalty paleosol and is recognized as a Bk horizon that caps the Georgetown unit. Bioturbation by plants and animals can be observed throughout the solum. The Georgetown alluvial sediments in the small and intermediate streams are fine-grained and mottled with gray and yellow, reflecting possible floodplain marshes or wetlands. Charcoal from a hearth provides the youngest age of the Royalty paleosol (8260 ±100 B.P. [GX15762]). This age is also considered the ending timeframe for deposition of this alluvial unit and the beginning of an erosional event that removed the A horizon (Nordt 1992). This is supported by a soil humate sample that returned the age 9110 ± 100 [Beta-44297] (Nordt 1995).

The Fort Hood alluvium overlies the Georgetown alluvium. Charcoal samples indicate deposition resumed after truncation of the Royalty paleosol and continued to approximately 6800 B.P. In small basins, discrete cut and fills are observed where gravel beds are overlain by thick, fine-grained strata containing diffuse gravels. The surface soil is a yellowish brown, silty clay loam (A-Bk) with encrusted carbonate filaments. Sediments of the Fort Hood alluvium indicate the channels of intermediate and small streams adjusted by braiding in the early Holocene.

The West Range alluvium is the next youngest. It is subdivided into two members that are defined by radiocarbon ages, sediment texture, and geomorphology. The older, lower member is estimated to begin deposition at 4300 B.P., ending 2400 B.P. or possibly 1700 B.P. in some cases (based on bulk humate samples). Deposition of the upper member began 2800 B.P. to 1700 B.P., and ended between 800 and 600 B.P. The West Range alluvium consists of sediments that are highly variable. While all alluvial units are dependent upon stream setting, the West Range is reported to be even more dependent than the other units identified in this study. In general, the sediment load is coarser-grained when compared to the Fort Hood alluvium, evidence that continued drying was taking place in the Holocene. Nordt (1992) suggests that this drying resulted in continued channel entrenchment, where the finer-grained materials were stripped previously and the underlying coarser sediments became the source of alluvial parent material. In the lower member of small streams channel fills are shallow and stacked, reflecting limited lateral channel migration. In the upper member, small streams are generally finer-grained than the lower member. The upper member also exhibits less vertical relief between channel and overbank facies. It is often buried by the next youngest unit, the Ford alluvium. Surface soils of the West Range unit are grayish brown loams exhibiting A-Bk and A-Bw profiles, with mycelial calcium carbonate forms.

The youngest alluvial unit is the Ford alluvium, found on the modern alluvial floodplain on the innermost meanders of streams. It comprises modern and partially buried channel bars that are buried by overbank deposits. The uppermost strata have been deposited in the last 50 years and are characterized as coarse-grained sediments, 30 cm thick. Changes in texture reflect wide fluctuations in flood magnitude. On small streams this unit was found to truncate or onlap the West Range alluvial members.

Lithostratigraphic Correlations

Geoarchaeological investigations at Fort Hood (Nordt 1992, 1995) and Buttermilk Creek downstream from the Gault site (Gibson 1997) support the relative chronology of the stratigraphy recorded for the TAMU excavation block. Unit correlations are summarized in Table 2.

Based on relative position and composition, units 1 (colluvial gravels), 2 (channel gravels), and 3a – 3b correspond with the Lankford alluvium of Buttermilk Creek and the Jackson alluvium at Fort Hood. In each of these, basal gravels were deposited on a scoured bedrock surface then overlain with overbank clay sediments. Units 3a and 3b, the deposits bearing Clovis diagnostic artifacts, indicate the clays were deposited prior to 11,000 B.P. Nordt (1992) reported an age of 15, 230 B.P. for the basal gravels in the Jackson alluvium.

Table 2. Regional Stratigraphic Correlations

Gault TAMU Excavation	Buttermilk Creek*	Fort Hood**	Radiocarbon (yr B.P.)**	Cultural Period***
1, 2, 3a, 3b	Lankford	Jackson	Ca. 15,000	Early Paleoindian
4b, 4c	Roden / Brown	Georgetown / Royalty	10,000 – 8000	Paleoindian / Early Archaic
5b	Solona	Fort Hood	7000 – 4800	Archaic
6b1	Lim	Lower West Range	4000 – 2000	Archaic
6b2	(erosional period)	Upper West Range	1650 – 600	
7b	Eden, Adams	Ford	≤ 400	Archaic - Recent

*Gibson 1997
**Nordt 1992, 1995
***Nordt 1995; Prewitt 1985

Units 4b and 4c are confidently correlated with the overbank facies of the Roden alluvium of Buttermilk Creek and the Georgetown alluvium at Fort Hood on the basis of composition, pedology and diagnostic artifacts. These units comprise are composed of silty clay and clay, with inclusions of calcium carbonate nodules. A distinct buried soil, the Brown paleosol (Gibson 1997) and the Royalty paleosol (Nordt 1992) serves as a marker horizon; the upper portion is truncated leaving a Bk-Bk-BC solum. TAMU excavations recovered Paleoindian Folsom and Angostura points from unit 4b, which agrees with the radiocarbon ages obtained from bulk humates and charcoal samples by Gibson (1997) and Nordt (1992, 1995) indicating deposition of this unit occurred between 10,000 and 8,000 B.P.

Unit 5b is correlated with the overbank facies of the Solona alluvium (Buttermilk Creek) and the Fort Hood alluvium based on relative position to the underlying units.

These units also contain report calcium carbonate filaments and nodules. Nordt (1995) placed deposition of this unit between 7000 and 4800 B.P.

Unit 6b is correlated with the Lim / West Range alluvium based on relative position and diagnostic points associated with the Archaic period that were recovered from the Gault excavation. Gibson (1997) correlated the Lim alluvium with the West Range lower member at Fort Hood, but indicated the West Range upper member corresponds with a period of erosion in the Buttermilk Creek lithostratigraphy. Deposition of the Lim and West Range lower member is estimated between 4000 and 2000 B.P.

Unit 7b is correlated with Eden – Adams units of Buttermilk Creek and the Ford alluvium at Ford Hood based on position and diagnostic artifacts, although the history of non-systematic excavations at the Gault site precludes assuming these deposits are intact. Burned rock material associated with the Archaic, projectile points, and modern materials can be found in this unit. Nordt (1992) estimates deposition of the Ford took place from 1000 B.P. to present, while Gibson (1997) estimated deposition of the Eden alluvium began around 2300 B.P, ending around 135 ±150 B.P (A-9563). Deposition of the Adams alluvium has continued over the last 100 years.

Summary

The natural and cultural layers that form the stratigraphic record of the TAMU excavation block provide information for reconstructing the last 15,000 years of deposition. Organic materials were not preserved that could be used for radiometric analyses. Previous research in the area supports the Gault relative chronology with radiocarbon ages.

During the Late Pleistocene and prior to Clovis occupation, Buttermilk Creek was a much larger force of energy which scoured the valley to the underlying bedrock surface and subsequently deposited the channel gravels of unit 2. Evidence of a scour with enormous energy is evident south of the excavation area, where more organic sediment fills the void left when a boulder or tree was dislodged from its location in the soft bedrock. The southern portion of the main excavation area is situated along the valley margin, where colluvial gravel (unit 1) is interfingered with alluvial gravel (unit 2) and subsequent overbank units 3a and 3b.

The first evidence of a Clovis occupation was preserved on point bar / channel facies and buried with clay sediments as Buttermilk Creek topped its southern bank. The low-energy floodwater receded or evaporated and a period of stability ensued long enough for a soil to develop on the surface of unit 3a. The sequence was repeated resulting in the deposition of Clovis period artifacts and unit 3b. A period of erosion is represented in the contact between unit 3b and the overlying unit 4b.

Units 4b and 4c are overbank sediments deposited during the Paleoindian and early Archaic periods, beginning around 10,000 B.P. (Nordt 1992, 1995). Diagnostic points associated with late Paleoindian periods (Folsom and Angostura) were recovered from these units (Luchsinger 2002). The paleosol that caps unit 4c is a regional marker horizon, the end of deposition reported by Nordt (1992) as 8260±100 (GX15762), obtained from hearth charcoal. A second age for the paleosol is 9110±100 (Beta-44298), obtained from soil humates (Nordt 1995). The truncated Bk-Bk-BC soil solum matches regional observations that a significant erosional event took place at 8000 B.P. A large pit excavated by pothunters from the surface into unit 4b was recorded in profile at the excavation block.

Units 5b through 7b represent floodplain aggradation over the last 7,000 years, from the early Archaic period to the present. Fragments from burned rock middens as well as diagnostic Archaic points are present, though deposits are often disturbed, at the Gault site (Collins 2002).

CHAPTER IV

GEOARCHAEOLOGICAL INVESTIGATION OF NATURAL FORMATION PROCESSES

Archaeologists are now very much aware that the archaeological record – cultural features and artifacts and their relationships – is part of a dynamic universe where natural and cultural processes are at work changing the record's original patterns (Butzer 1982; Collins 1975; Hassan 1987; Isaac 1967; Shackley 1978; Shipman 1981; Schiffer and Rathje 1973; Schiffer 1983, 1987; Wood and Johnson 1978). Close on the heels of this ideology is the understanding that researchers must not assume a site's integrity, or artifact relationships, based on appearances. The list of potentially transforming factors can seem endless but can become manageable by considering, on a case by case basis, the variables that have the most applicability (Hassan 1985; Schiffer 1983). From stratigraphic investigations, researchers can identify the depositional environment(s) and reconstruct the geomorphic landscape, as well as the climate, vegetation, and fauna. The modern setting is also a factor to consider. As much as humans are a component of an ecological system, the archaeological record continues as a component of the natural environment, subject to its ongoing processes.

Stratigraphy at the TAMU excavation area places this portion of the Gault site on the valley margin sandwiched between the Balcones Escarpment and the paleochannel of Buttermilk Creek, near the creek's head. Underground springs maintain a perennial stream while surface runoff increases stream discharge seasonally. The climate in eastern central Texas is mild with wet and dry seasons. In clayey sediments, wet/dry cycles are reflected with vertical cracking up to meters deep. Vegetation includes grasses, shrubs, and trees, which also support a woodland faunal community. Potentially disturbing natural agencies to consider at this location include stream action, pedoturbation, and bioturbation. Colluvial processes are active at valley margins and while the excavation area is positioned near the base of an escarpment, stratigraphy indicates cultural materials are part of the alluvial units. Consequently, this study is focused on identifying patterns that reflect the influence of hydrological, pedological, and biological agents.

Natural Formation Processes Study

The principles of hydrology are used to evaluate archaeological site formation and integrity in alluvial settings (Schiffer 1987; Waters 1992). Given enough strength, current flow will orient elongate particles parallel or perpendicular to the directional force (Johansson 1963; Isaac 1967; Kelling and Williams 1967; Rust 1972; Shackley 1978). Gravel and cobbles-sized particles that are closely packed in or near the channel often become imbricated, with the vertical dips facing upstream. In an experimental study, Schick (1987) found that, given the right amount of energy to entrain particles, fluvial action will disperse smaller materials and reorganize them in a splay pattern slightly downstream from the original site location. Other signs of fluvial action include abraded edges on particles and absence of smaller sized particles such as microdebitage.

Using multiple lines of evidence, Dibble et al. (1997) concluded artifacts recorded at a Lower Paleolithic site in France were significantly dispersed by stream action. Artifacts showed a preferred orientation parallel to stream flow with a secondary preferred direction that followed the slope of the terrace. Patterned dip measurements indicated artifacts and surrounding matrix were imbricated. Noncultural artifact edge damage, matching weight distribution with nonartifactual material, and lack of microdebitage proportional to the overall assemblage provided additional support for this conclusion (Dibble et al. 2007:638). At the Mill Iron site in Montana, Ingbar and Larson (1992) used orientation analysis to determine that although postdepositional processes slightly tilted and aligned artifacts parallel to the slope, the spatial patterns were not significantly modified from the original positions.

Orientation analyses provide insight to spatial relationships on a predominantly horizontal plane. An effective way to examine the vertical spatial relationships is with a study of refitting artifacts (Hofman 1981; Villa 1982). Although time-consuming, the effort is worth the expenditure because the results of refitting artifacts can be examined on several levels, such as manufacturing techniques, artifact life-history, and intra / intersite relationships (Cahen et al. 1979; Cziesla et al. 1990; Hofman and Enloe 1992; Odell 2000). Artifact pieces that have been reassembled fall into three categories: portions of one, broken during its use-life or post-depositionally; artifacts that can be rejoined sequential relative to the manufacture process; and artifacts that are confidently matched from the same nodule but not exact physical matches (Ingbar and Larson 1992; Odell 2000). The foundation of refitting is that something that was once a whole, such as a ceramic pot or chipped stone flake, represents an event in time. Thus, the first category of refits can tie discrete spatial units in time. The second category accomplishes this as well, keeping in mind that sequential pieces may also be the result of recycling (Schiffer 1983). The third category is best used with the support of additional analyses to lend weight to any conclusions that are drawn regarding spatial associations. However, insight can be gained with regard to behavioral activities when "ghosts" and "orphans" are identified (Odell 2000).

Cahen and Moeyersons (1977) applied refit analysis to detect postdepositional movement in massive sand deposits at the Acheulian site, Gombe Point, in central Africa. Refitting groups were identified between artifact concentrations at different radiocarbon-dated depths and out of reduction sequence, negating the possibility that materials had been recycled by more recent occupations. This significant study required researchers to reclassify stone tool technology for this period and region. Hofman (1986; 1992b) applied a study of refitting chipped stone artifacts to identify an occupational surface at the Cave Spring site, recorded in alluvial deposits of the Duck River in Tennessee. Refitted artifacts showed post-depositional movement up to 40 cm, despite clear stratigraphy. The Cave Spring assemblage was interpreted as belonging to one occupation level instead of a multi-level site and the refit study was critical to making this interpretation. The spatial patterns of artifacts recovered from the Gault TAMU excavation block may have been influenced by stream action or post-depositional processes. The following section reports the artifact orientation analysis and refit study aimed toward evaluating the context of the assemblage recorded in the Clovis clays.

Artifact Orientation Analysis

Methods

Artifacts recovered from the Gault site TAMU excavation were examined as sedimentary particles with two purposes in mind: to gain further insight for reconstructing the depositional environment that led to the accumulation and subsequent burial of the assemblage, and to evaluate the degree of disturbance that may have occurred once the artifacts became part of the archaeological record. As excavations progressed through the cultural deposits bearing Paleoindian artifacts, excavators referenced local datum to record the horizontal and vertical positions of artifacts with one length larger than 2.5 cm. At the end of a 5 cm excavation level, and at sublevels when artifact density required, a compass was used to record the direction of an in situ artifact's long axis relative to magnetic north. (Every effort was made not to dislodge materials; in the event that an artifact was possibly out of situ, orientation data was not collected.) The degree of dip for the upward face was then recorded using the compass clinometer, followed by the face direction relative to magnetic north. (Note that dip measurement was not always measured perpendicular to the long axis due to the occasions when the direction of the dipped face coincided with the long axis.) The three-dimensional coordinate data were correlated to the geologic units identified in the stratigraphic analysis. Records that could not be confidently placed in a geologic level were excluded from this study.

Rose diagrams were created (*Rose 2.0.4,* Thompson 2003) using data that was compiled for each geologic unit 3a and 3b. Additional rose diagrams were then created to look for smaller-scaled patterns within each geologic unit by combining the 23 excavation units (each 1 m^2 into five contiguous groups, to prevent small-scale patterns of long axes orientation from being obscured yet maintain sufficient number of observations (Davis 2004). Rose diagrams are unidirectional to simplify visual inspection. Because the data is planar, descriptive statistics are reported for bidirectional circular data (personal communication, T. Thompson 2005). Direction and degree of dip information was graphed with histograms and scatter plots and variation statistically analyzed using non-parametric tests (*SPSS 7.5*).

Results

Long Axis Orientations (Strike)

Table 3 lists the descriptive statistics for long axis orientations recorded in units 3a and 3b. Preferred orientation was not identified statistically and mean resultant length/consistency ratio closer to zero than one indicates wide dispersion of vectors. Angle deviations average 80 degrees, also indicative that vectors are not clustered. Visual inspection of long axis data found all directions were well represented in both geologic units, with a potential but very slight preferred orientation discernable toward the north/northeast (see Figure 5*)*. When the compiled data is broken into smaller groups of excavation units, this minor preferred orientation is observed only in the central-northern groups of Unit 3b and then in the northern group of Unit 3a. This pattern does not extend into the northernmost excavation unit group (see Figure 6).

Table 3. Long Axis Orientation Summary.

Geo Unit	*N*	Maximum class (%)	Vector Mean	Angular deviation	Vector magnitude	Consistency Ratio
3b	336	10	-41.67	±79.49	12.63	0.0376
3a	614	10	116.26	±80.39	9.6	0.0156

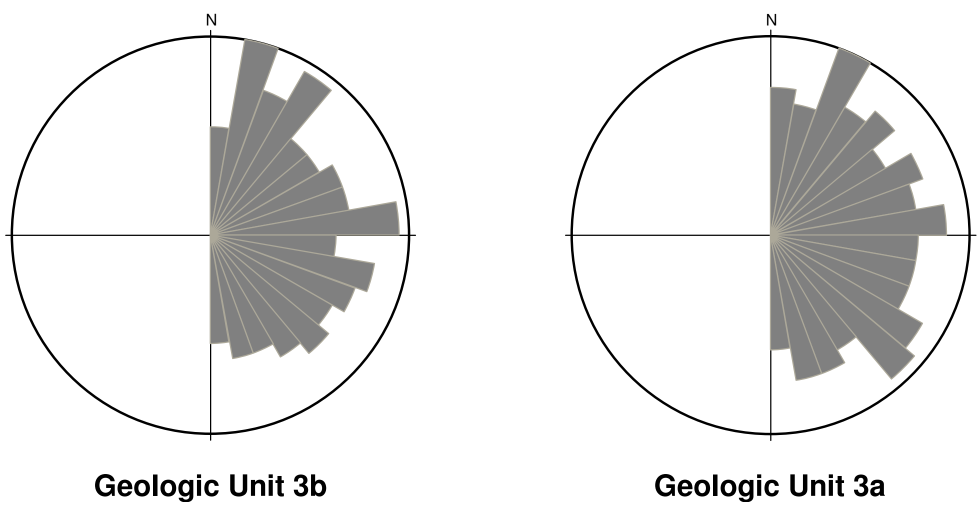


Figure 5. Artifact long axis orientations for all excavation units within the geological units 3a and 3b.

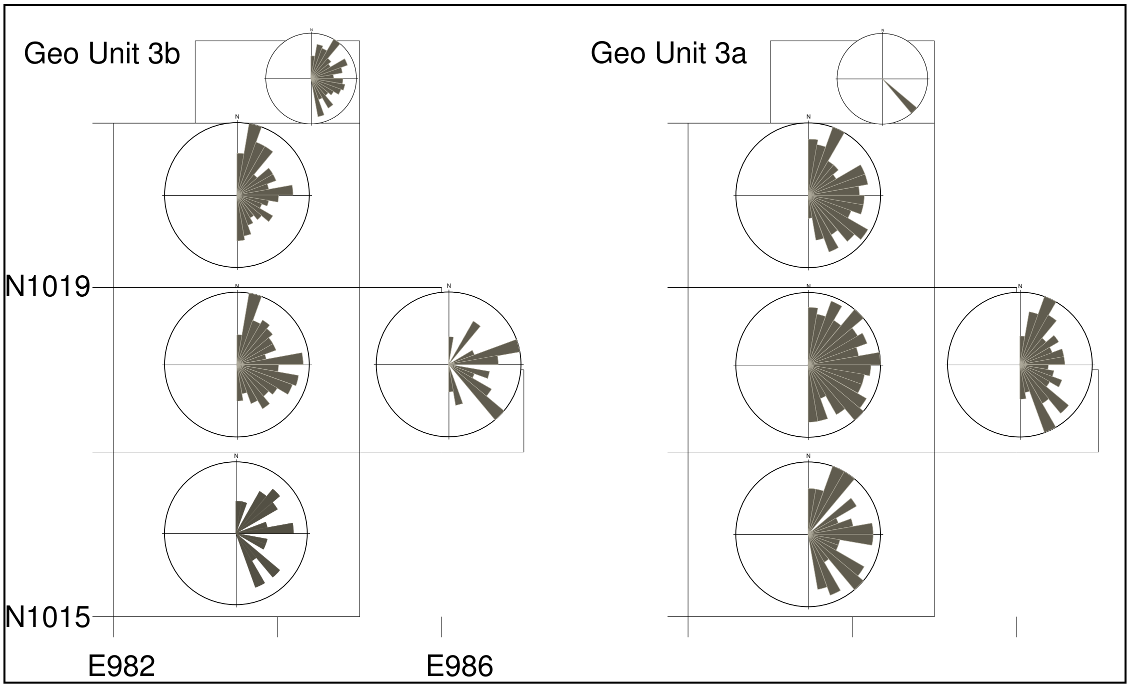


Figure 6. Artifact long axis orientations for grouped excavation units within the geological units.

Artifact Inclination (Dip) - Variation between the Geologic Units

Dipped artifacts did not differ significantly in their distribution among the cardinal directions when strata were compared ($\chi^2 = 6.88$, $p = 0.0758$). A significant difference was observed for the angle of inclined artifacts (t (940) = -2.006, $p = 0.045$; Man-Whitney Z = -2.274, $p = 0.0230$), with Unit 3b having a higher mean degree of dip than 3a, however the difference is small (Unit 3b = 30, Unit 3a = 28; see Figure 7).

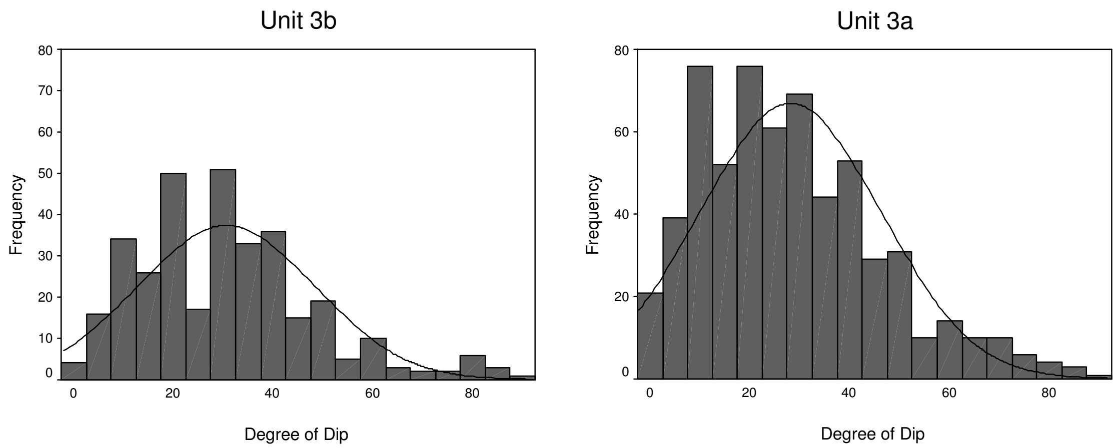


Figure 7. Artifact degree of dip summary data.

Artifact Inclination (Dip) - Variation within Geologic Units

Dipped artifacts also did not show a significant difference in their distribution among cardinal directions when each stratum was compared to a theoretical distribution (Unit 3b $\chi^2 = 4.27$, $p = 0.2390$; Unit 3a $\chi^2 = 5.79$, $p = 0.1224$). The mean degree of dip for the cardinal directions did not differ significantly within unit 3b (Kruskal Wallace χ^2 (3) = 0.964, $p = 0.810$), but a significant difference was found in unit 3a where artifacts inclined to the north and east had a higher mean degree of dip than those inclined to the south and west (Kruskal Wallace χ^2 (3) = 9.319, $p = 0.025$; see Table 4).

Table 4. Direction of Dip by Cardinal Directions.

	Mean	*N*	Standard Deviation		Mean	*N*	Standard Deviation
3b				3a			
North	29.78	90	17.894		29.69	153	18.600
East	30.58	67	18.835		30.61	163	16.566
South	31.98	89	18.162		27.77	158	17.771
West	30.44	86	16.235		25.78	125	18.730
Flat	.00	1	-		.00	10	.000
Totals	30.61	333	17.742		28.15	609	18.143

There does not appear to be a horizontal or vertical distribution pattern for direction of dip beyond distribution to correspond with the extents of the geologic unit deposits. Scatterplots were calculated using northing and easting as x and y axes, respectively, and show artifacts dipped in all cardinal directions throughout the geologic units under study. Figure 8 shows artifact direction/degree of dip for unit 3b, distributed across the deposit with no apparent relationship between northing and easting, or northing and elevation (see Figure 9). Artifacts are also randomly dipped on the horizontal plane of Geologic unit 3a, although distribution of artifacts shows an easterly channel extending through N1017.5 / N 1018.00, E 982 to 986 (see Figure 10), with a maximum depth of 15 centimeters (see Figure 11).

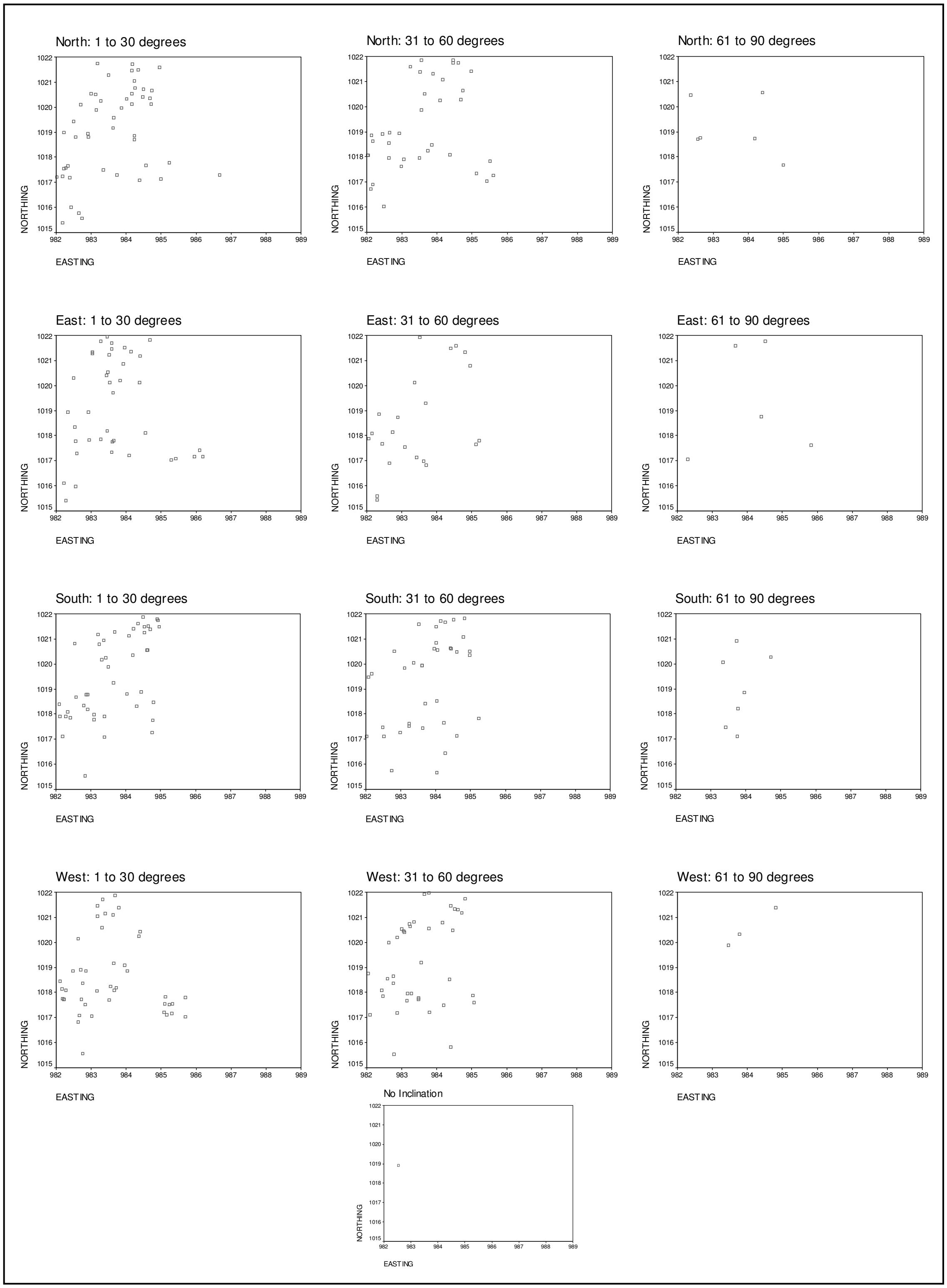


Figure 8. Artifact orientation data by northing and easting for unit 3b.

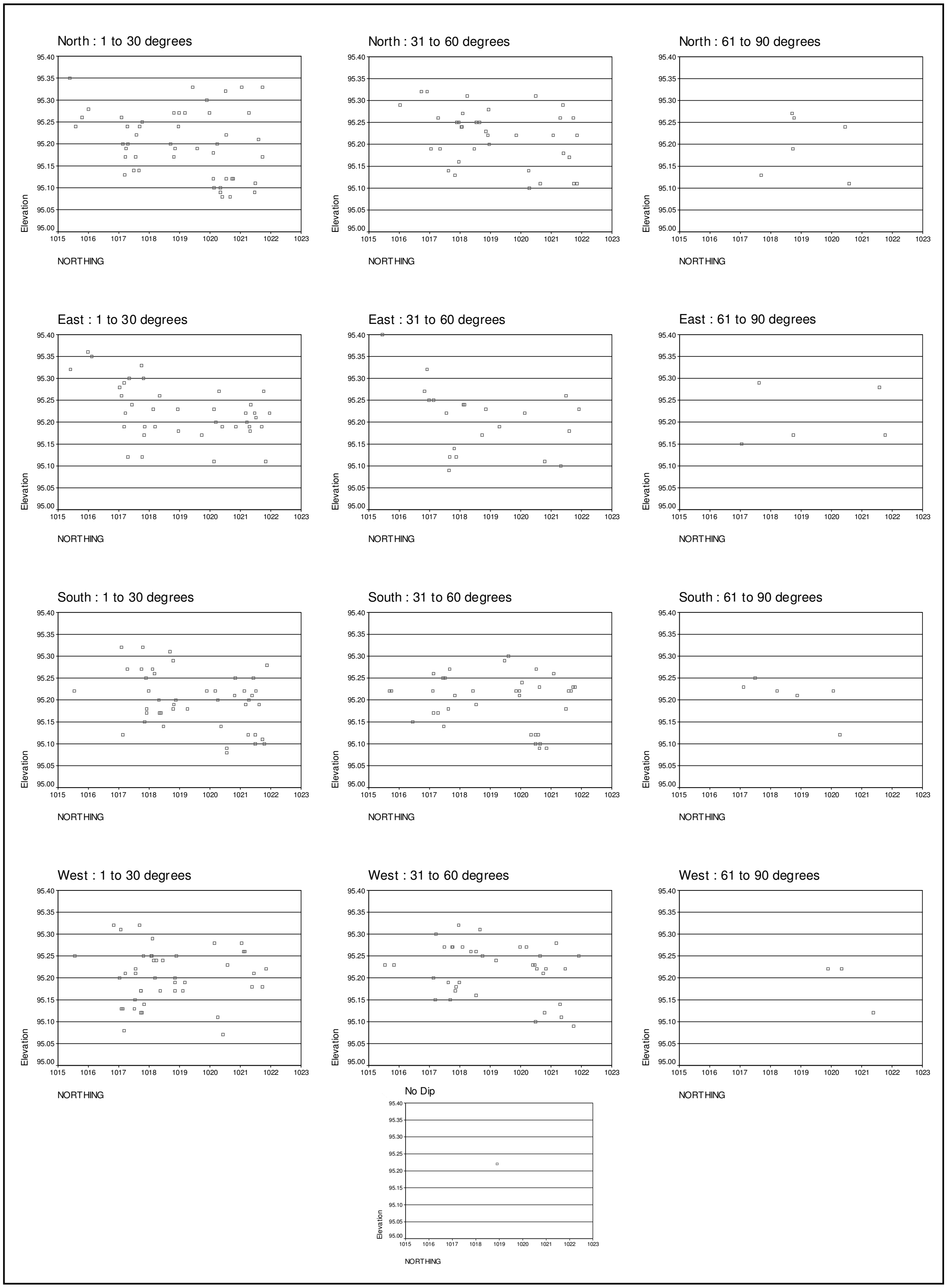


Figure 9. Artifact orientation data by northing and elevation for unit 3b.

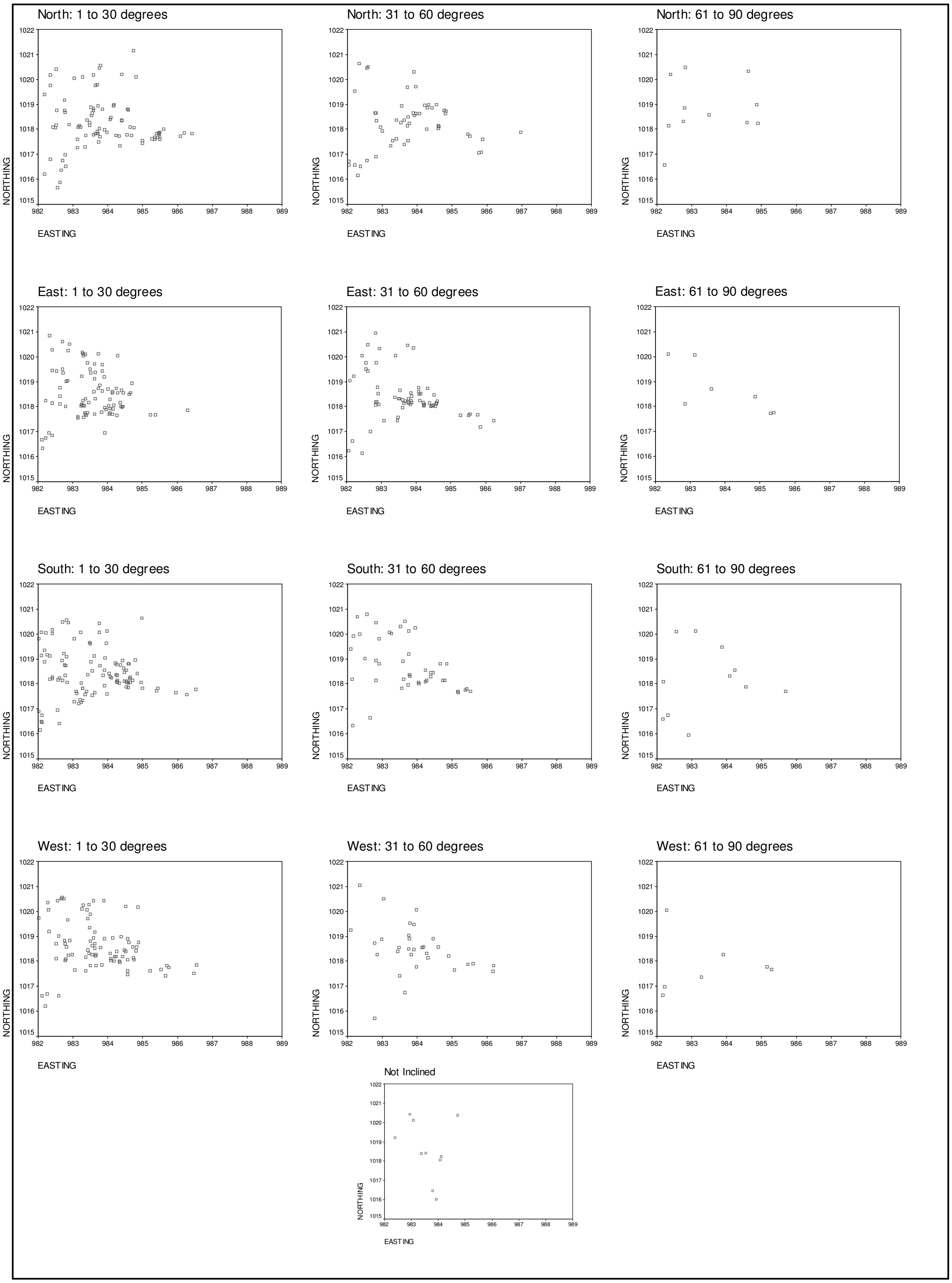


Figure 10. Artifact orientation data by northing and easting for unit 3a.

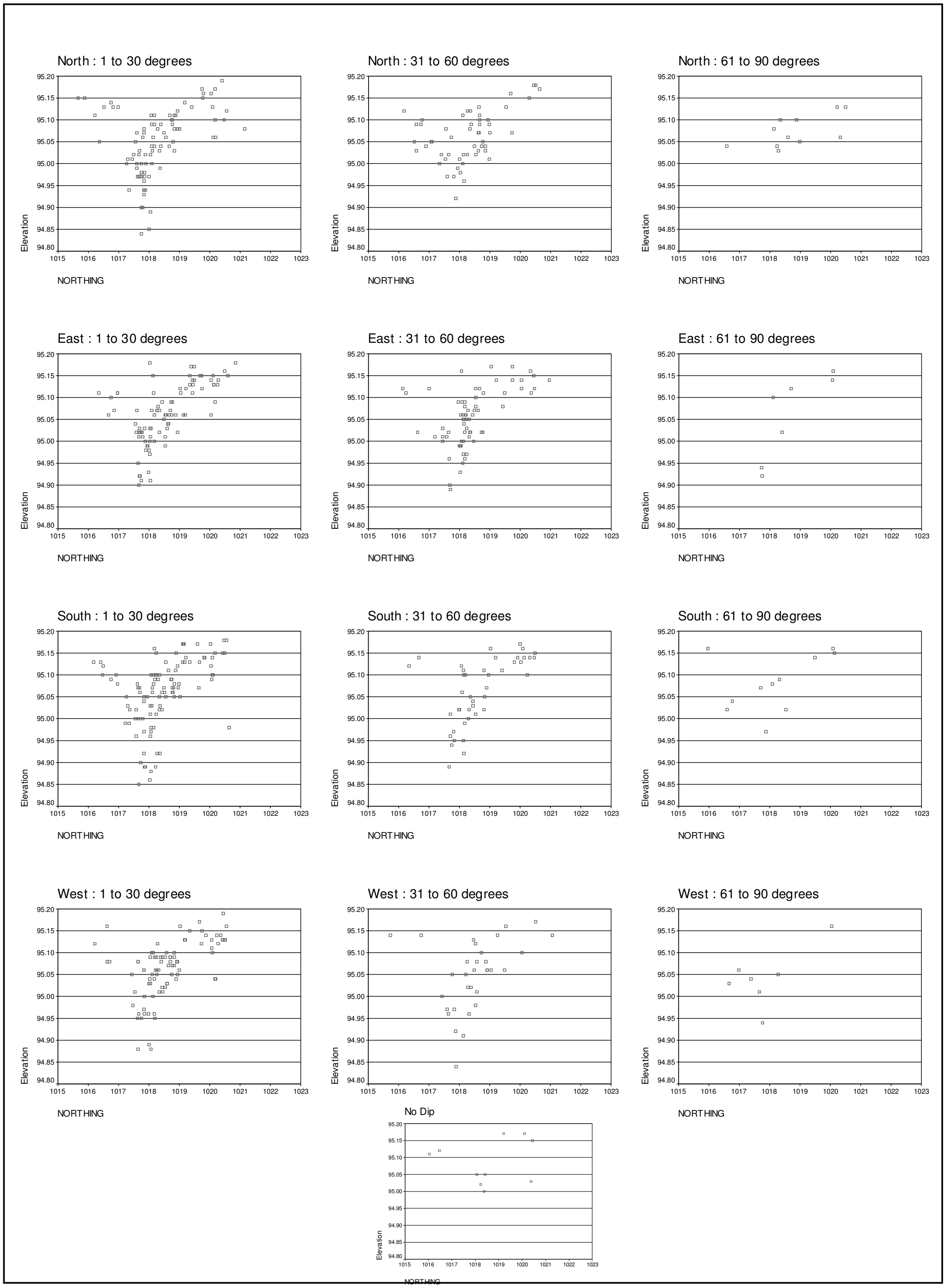


Figure 11. Artifact orientation data by northing and elevation for unit 3a.

Conclusions

Orientation data reflects a relatively high degree of contextual integrity, with a slight preference for the general paleotopography recorded in the stratigraphy. Circular statistics did not find preferred orientation. Visual inspection of long axis orientations shows artifacts oriented to all directions, with possible preferred orientation toward north-northeast in central and north-central groups of 3b, north central group of 3a.

When direction and degree of dip information was compared between strata, unit 3b was found to have a higher mean degree of dip by 2 degrees (30 vs. 28 degrees) and no significant difference found in distribution of cardinal directions. No significant difference found when direction of dip information was compared to a theoretical distribution for each stratum.

Artifacts inclined to the north and the east in unit 3a were found to have a higher mean degree of dip than those inclined to the south and west. Visual inspection of scatterplots indicates northing and easting were not found to predict degree or direction of dip in either unit, with the possible exception of unit 3b artifacts steeply dipped to the west, clustered in north-central excavation area.

Horizontal and vertical distribution of dipped artifacts appears to follow stratigraphy. Artifacts with that were horizontally level in unit 3a are not recorded below elevation 95.00, the elevations where the channel appears to have been filled. Artifacts in unit 3b have distribution that is homogenous in thickness, with level upper and lower boundaries. Artifacts in unit 3a reflect distribution that indicates a break in the horizontal surface in the south-central area, maximum 15 cm depth and approximately 1 m wide, trending east-west.

Artifact Refitting Study

Methods

The study comprised three sample sets examined at separate times: (1) point-plotted artifacts from geological units 3a and 3b ("Clovis Clays"), not including bifaces, blades, overshot flakes, core tablet flakes, or large flakes, (2) blades from the geologic units 3b and 3a, and (3) the same artifact types as in set (1) but reduced horizontal extent of a 2 x 2 m block (4 units) and expanded vertically (excavation levels through geologic unit 4c), this last set designed for to increase the probability of identifying refit groups based on the basis of high artifact counts in the 3a and 3b levels. Stackelbeck (2000) and Hofman (1981) report success with refit investigations undertaken after the artifacts have been analyzed according to attributes. Although this study was completed at the same time as technical analyses, refits were identified during analyses by other researchers and are included gratefully in this report.

Labeled artifacts recovered from the Clovis clay deposits were organized by excavation unit and level and placed in shallow, divided boxes on a large table. Refit study participants looked for matches first within a unit and level, then expanded the search to horizontally and vertically adjacent units, and then searched non-adjacent units. Nearly 100 percent of the chipped stone assemblage consisted of a single material, Edwards chert. To facilitate identifying a match, artifacts were often grouped by attributes related to technical classification (core, cortical/noncortical flake, blade) and physical characteristics such as color patterns, cortex features, unique banding, and macro-inclusions. Minimum analytical nodules (Odell 2000) were not considered at the time the study was designed and are beyond the scope of this research.

Artifacts with point provenience information are reported with those values, to the nearest millimeter. Artifacts recovered from the screen were assigned average provenience measurements according to excavation unit and level (center of 1 x 1 m unit and elevation midpoint for each 5 cm level). Where more than one artifact is in a group, the greatest vertical and horizontal distance values were used in tabulations.

Excavation levels were translated to geological units post-excavation by Dr. M. Waters. The 3a/3b designation as a transition zone became necessary because a clear contact could not be discerned in certain sections of the profile walls during the fieldwork. Micromorphological investigations identified evidence of a soil between units 3a and 3b that has been obscured through the activity of microorganisms (Luchsinger 2002). In addition to identifying contemporaneous artifact movement between geologic units, refit groups with an element in this unit may indicate continuity of occupation(s).

Approximately 170 hours was devoted to examining the sample sets, finding the first 24 groups. Additional refits were identified during separate technical analyses. Scott Minchak provided technical descriptions for blades; Charlotte Pevny and William Dickens provided technical attribute information for all other aspects of the assemblage.

Results

Thirty-three groups consisting of refitting pieces (n=73) were identified for use in this study, representing a fraction (0.1 percent) of the total assemblage from the geologic units 3a and 3b (n = 66,000; Pevny and Carlson 2008). A complete inventory of refits groups is provided in Appendix A. Two groups (22, 23) were excluded due to equivocal contact surfaces; two other groups (N1, N2) were excluded because the breaks occurred during excavation; a fifth group (36) was excluded because the pieces are an un-modified river cobble recovered from unit 2. All other refit groups that were identified were recovered from the Clovis-bearing clay deposits, geological units 3a and 3b. Figure 12 shows the 33 refit group distribution between units 3a and 3b.

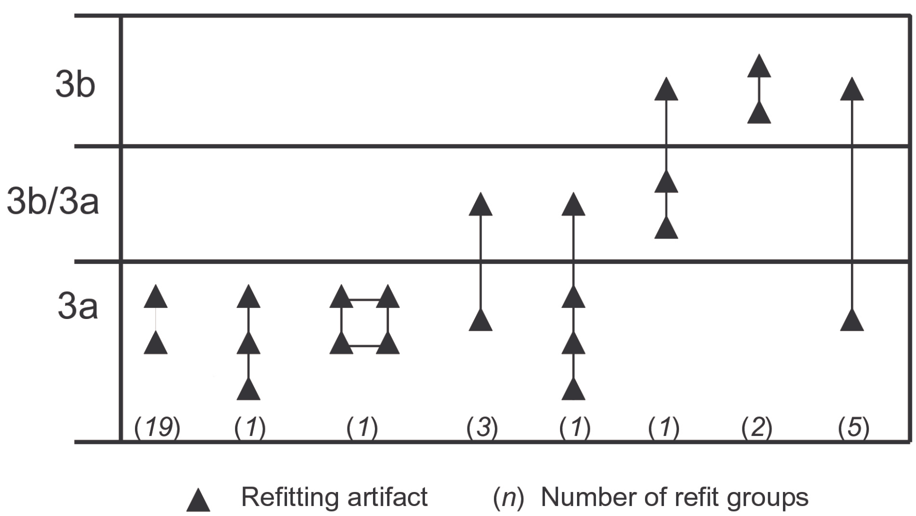


Figure 12. Refit group distribution between units 3a and 3b.

Twenty-two refit groups (67 percent) had a vertical difference of 5 cm or less between pieces. The maximum vertical difference measured 20 cm (group 28); mean difference equaled 6 cm, and the mode value was zero (no measurable vertical difference). Of the 33 refit groups used for tabulations, 19 consist of fragments that refit and 15 were sequential refits. A summary of refit groups is provided in Table 5.

Since one of the sample sets examined for refits focused on a 4 x 4 m area where artifacts were recorded in high concentrations, the horizontal distribution of refitting pieces is biased to a certain degree in favor of this central area of the excavation block. Few refit groups were identified during this portion of the study however, therefore the bias is considered small. Of the 33 groups, 91 percent of the refitting pieces are located within 2 m of each other. The majority of refitting pieces recovered from unit 3a are confined between the north 1017 and 1020 lines (see Figure 13), extending east and west the length of the lithostratigraphic unit. The maximum horizontal distance measured 2.8 m (refit group 31), although the vertical difference measured zero. The two refit groups recovered from unit 3b are tightly situated (all four artifacts were point-provenienced with no measurable horizontal distance) within one excavation unit, toward the north end of the excavation block (see Figure 14). Refit groups with artifacts that appear to cross units 3a and 3b are depicted in Figure 15. Refit groups with artifacts recovered from levels where the boundary between unit 3a and 3b was not definitive (termed 3a/3b) are shown in Figure 16; the distributions in these cases appear to reflect their better-defined counterparts, although with few groups in unit 3b suggested correlations must remain tenuous.

Table 5. Refit Group Summary.

Refit Group	Refit Type	*N*	General Description	Vertical Distance (m)	Horizontal Distance (m)
Groups Crossing Geological Units 3a and 3b					
28*	Fragment	2	Blade	0.20	2.0
27	Fragment	2	Biface (stage II)	0.19	1.10
25	Fragment	2	Biface (stage III)	0.18	2.70
24	Sequential	2	Overshot and cortical flakes	0.11	1.50
21*	Fragment	2	Flake	0.11	0.25
Groups from Geological Unit 3a and Transitional Unit 3a/3b					
3*	Sequential	4	Core and flakes	0.05	1.00
12	Sequential	2	Flakes	0.04	1.60
20	Sequential	2	Flakes	0.18	0.75
32	Fragment	2	Biface (stage IV)	0.02	2.25
Groups from Geological Unit 3b and Transitional Unit 3a/3b					
10*	Sequential	3	Flakes	0.06	1.12
Groups from Geological Unit 3a					
13	Fragment	2	Clovis preform (stage VI)	0.15	1.75
26	Fragment	2	Biface (stage III)	0.07	1.00
5	Sequential	4	Core and flakes	0.07	1.00
29	Sequential	2	Blade and flake	0.06	2.00
8	Fragment	2	Flake and shatter	0.05	0.50
17	Fragment	2	Biface (stage V)	0.05	0.60
11	Sequential	2	Blades	0.04	0.10
30	Fragment	2	Flake	0.03	0.05
16	Sequential	2	Overshot flakes	0.03	0.85
7*	Sequential	2	Flakes	0.03	0.50
9*	Fragment	2	Flake	0.03	0.50
19	Fragment	2	Overshot flake	0.02	0.04
14	Sequential	2	Overshot flakes	0.02	0.25
6*	Sequential	2	Core and flake	0.02	0.73
2	Fragment	2	Overshot flake	0.01	0.2
4	Sequential	2	Core and shatter	0.01	0.25
15*	Sequential	3	Flake and shatter	0.03	1.60
18	Fragment	2	Overshot flake	0.00	0.02
1	Sequential	2	Blade and flake	0.00	0.25
34*	Fragment	2	Blade	0.05	0.50
31	Fragment	2	Blade or flake	0.00	2.80
Groups from Geological Unit 3b					
33	Fragment	2	Flake	0.00	0.00
35	Fragment	2	Overshot flake	0.00	0.00

*Group contains one or more artifacts recovered from the screen.

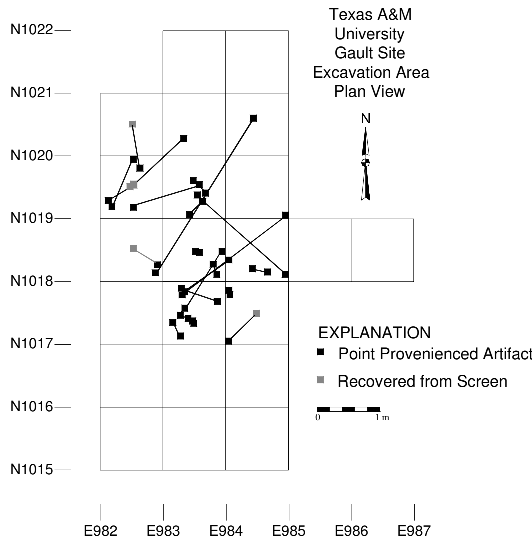


Figure 13. Horizontal distribution of refitting artifacts within unit 3a (n = 21 groups).

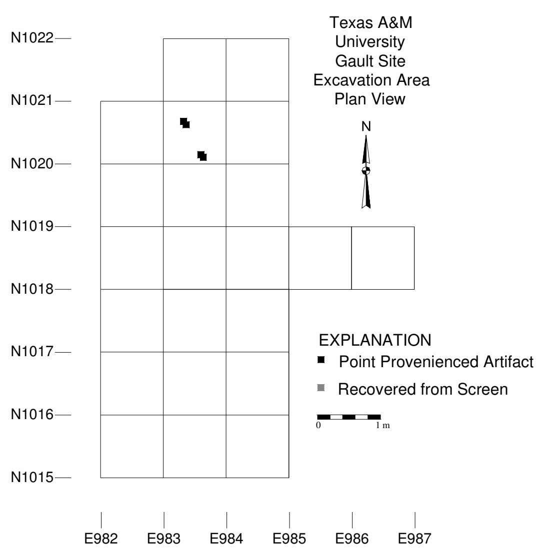


Figure 14. Horizontal distribution of refitting artifacts within unit 3b (n = 2 groups).

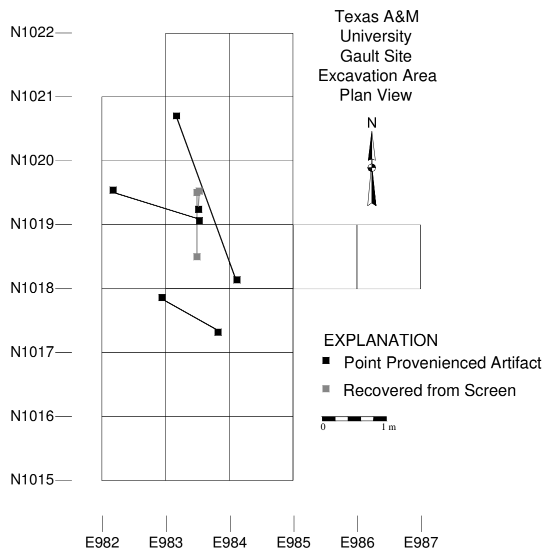
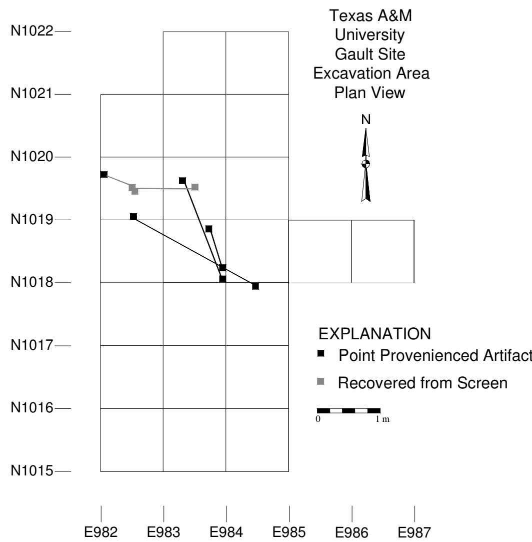


Figure 15. Horizontal distribution of refitting artifacts that cross units 3a and 3b (n = 5 groups).

(a)



(b)

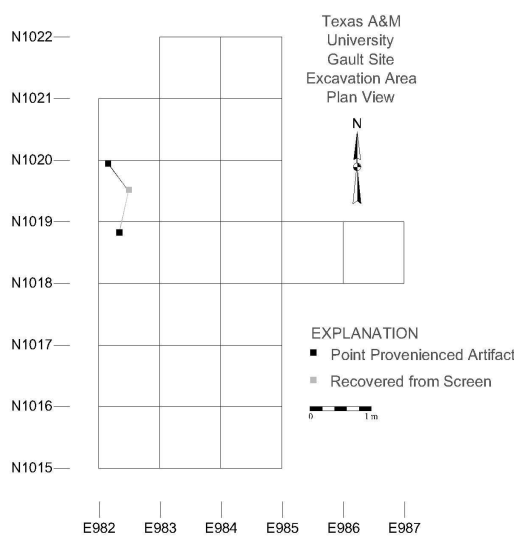


Figure 16. Horizontal distribution of refitting artifacts with one or more pieces in the transitional 3a/3b level: (a) unit 3a and 3a/3b (n = 4 groups), (b) unit 3b and 3a/3b (n = 1 group).

The following section reports characteristics of refit groups that cross geologic units, register high vertical separation or horizontal separations, or offer unique characteristics for within geological unit observations.

Refit Groups That Cross Geological Units

Five groups were identified that appear to have elements from both of these units. Four of these are fragment-style refits, and one is a sequential refit. Vertical distances range from 20 cm to 12.5 cm, among the highest values of all the groups. These groups also have higher horizontal differences, although horizontally distant refits with little to no vertical distance were also identified.

Group 28 comprises the medial and proximal portions of a non-cortical blade (Minchak 2007) recorded at the highest vertical difference (20 cm) and relatively high horizontal difference (2 m), although both of these artifacts were recovered from the screen and therefore positions are known to the nearest meter horizontally and within 5 centimeters vertically. Excavation unit records indicate the artifact currently designated from 3b, may in fact have some portion of unit 3a intruding.

Group 27 consists of the medial and proximal portions of a stage II biface that appears to have snapped during end thinning. They were recovered from adjacent units with a vertical difference of 15 cm and horizontal separation approximately 1.75 m. It is possible that a sliver of 3a intrudes into the overlaying 3b.

Refit group 25, comprises two stage III biface fragments, one of which retains some cortex (see Figure 17). These were not recovered from contiguous units, and registered vertical difference of 18 cm and horizontal difference of 2.7 m. Looting had occurred in the area west of the N1020 / E983 unit and is one cause to consider for displacement.

Figure 17. Refit group 25.

Group 24 is a sequential refit of two cortical flakes. One is an overshot flake with evidence of being heated (AM 182-B; recovered from unit 3b; see Figure 18b) that refits to a large cortical flake with no evidence of heating (AM-H3; recovered from unit 3a; see Figure 18a). The horizontal distance between artifacts measured 1.5 m and the vertical difference measured 11 cm.

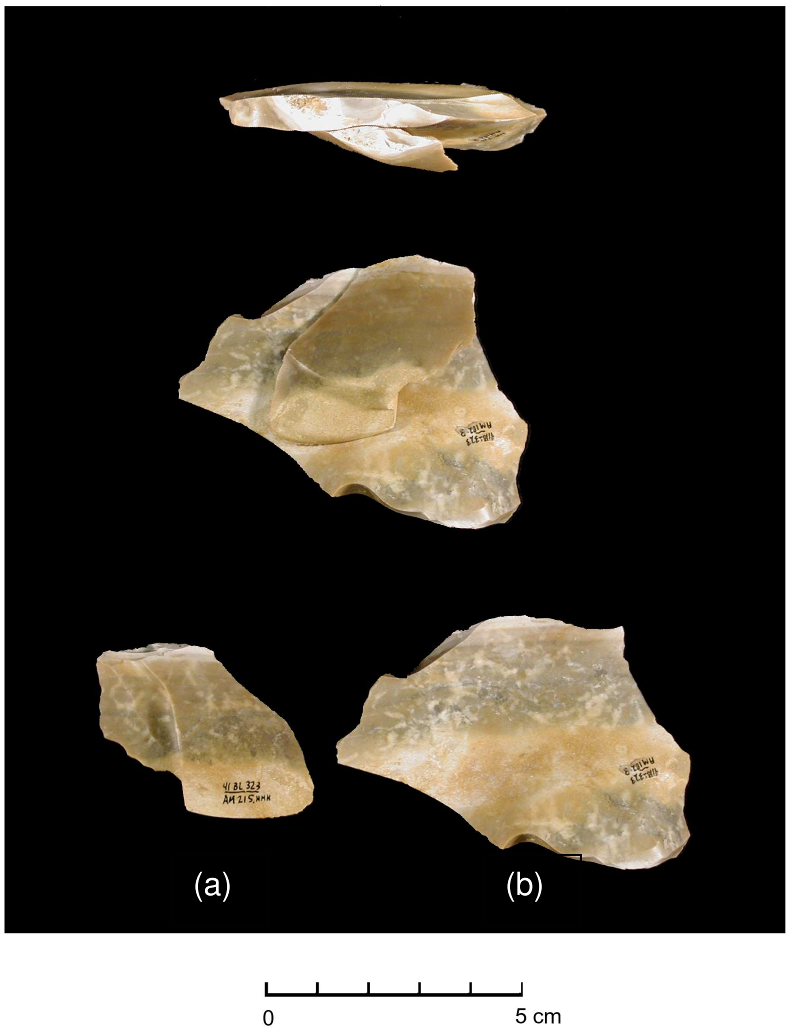


Figure 18. Refit group 24.

Figure 19 shows refit group 21, which consists of the medial and distal portions of a thin, non-cortical flake. The horizontal difference measured only 25 cm, while the vertical separation was 12.5 cm.

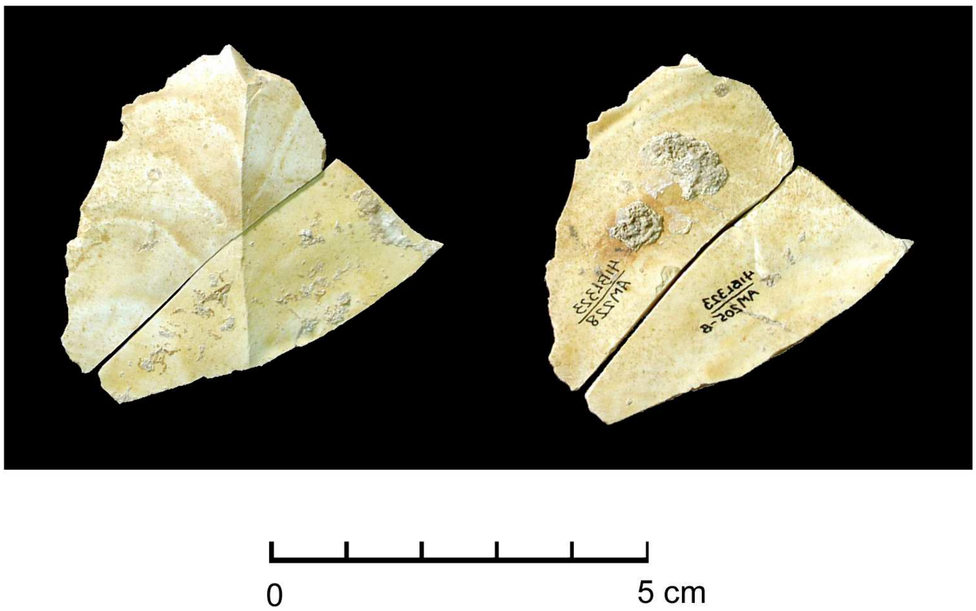


Figure 19. Refit group 21.

Selected Refit Groups from Unit 3a

Figure 20 shows Group 13, the proximal and distal portions that form a complete fluted perform (Stage VI). Both were recovered from geological unit 3a, although the vertical difference in elevation was 15 cm and horizontal distance between them measured 1.75 m. Both pieces have one side stained darker the other.

Group 26 consists of two stage III biface fragments that were recovered from unit 3a, with a 9 cm difference in elevation. The horizontal difference measured nearly a meter (0.9 m), notable because one of the fragments was burned after the biface was broken (see Figure 21).

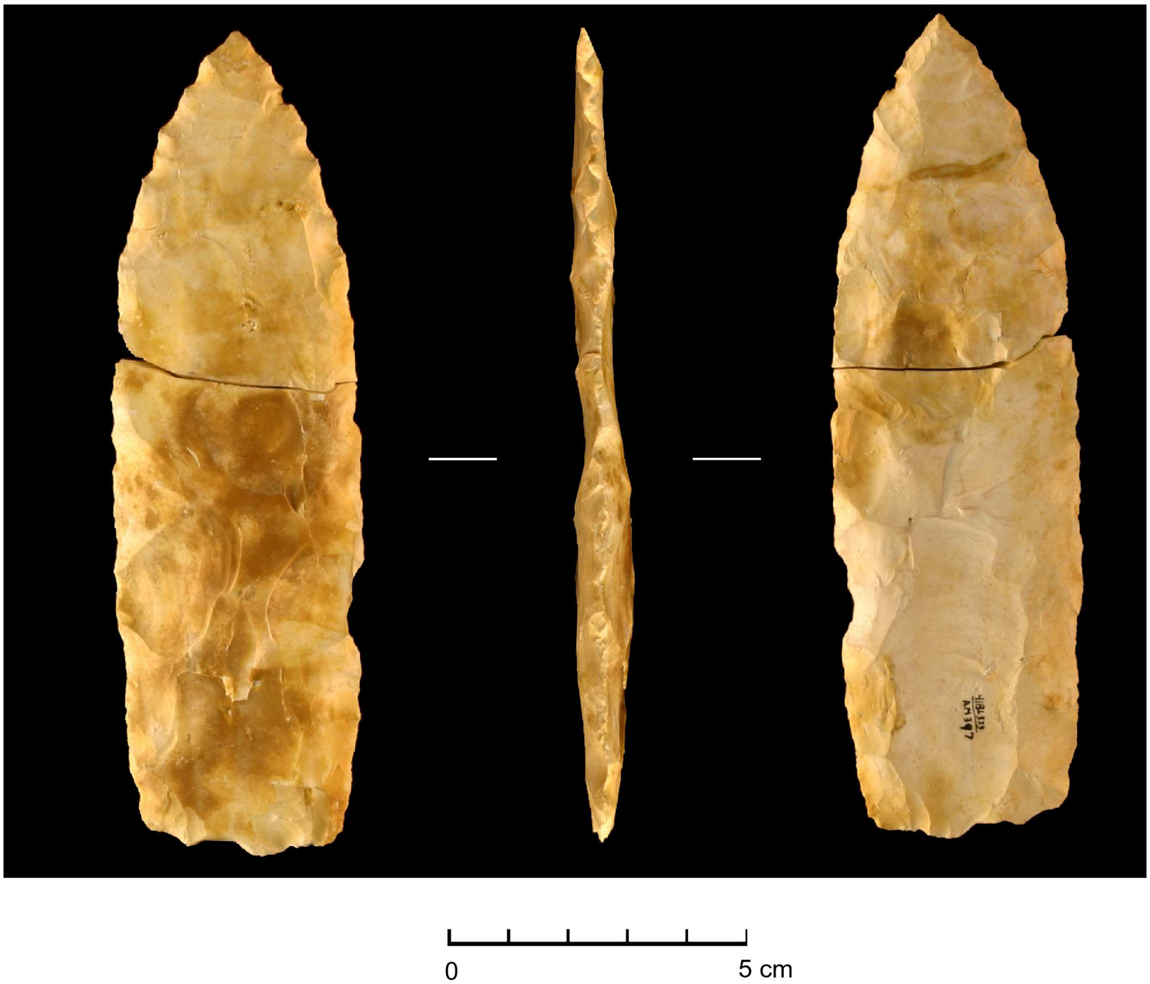


Figure 20. Refit group 13.

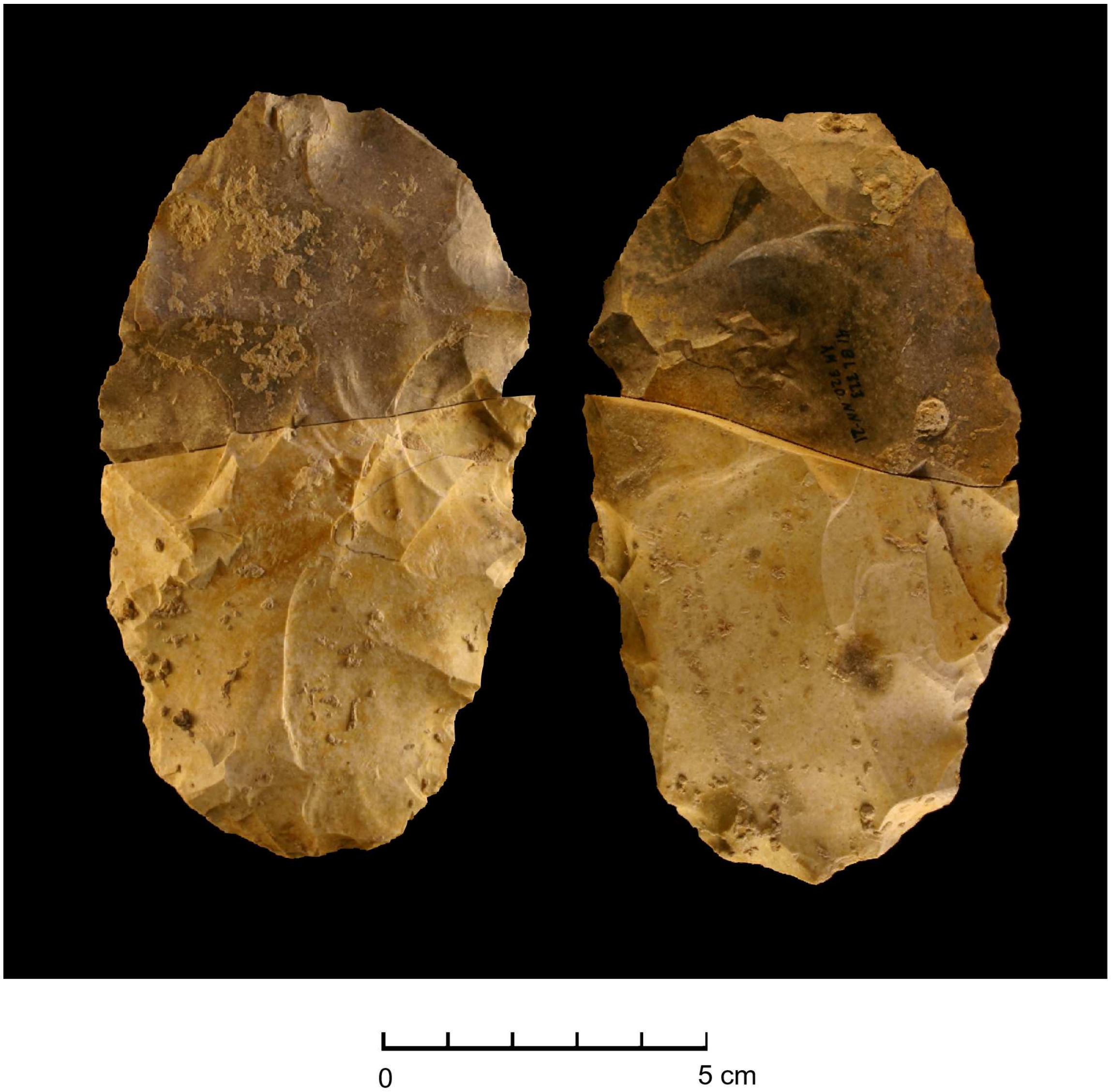


Figure 21. Refit group 26.

Group 5 comprises 4 sequential fits recovered from unit 3a (see Figure 22). The four pieces consist of a small core and three flakes. The core and first 2 sequential flakes were recovered from the same excavation unit and level. The last flake in the sequence registered the maximum distance from the core (1.0 m).

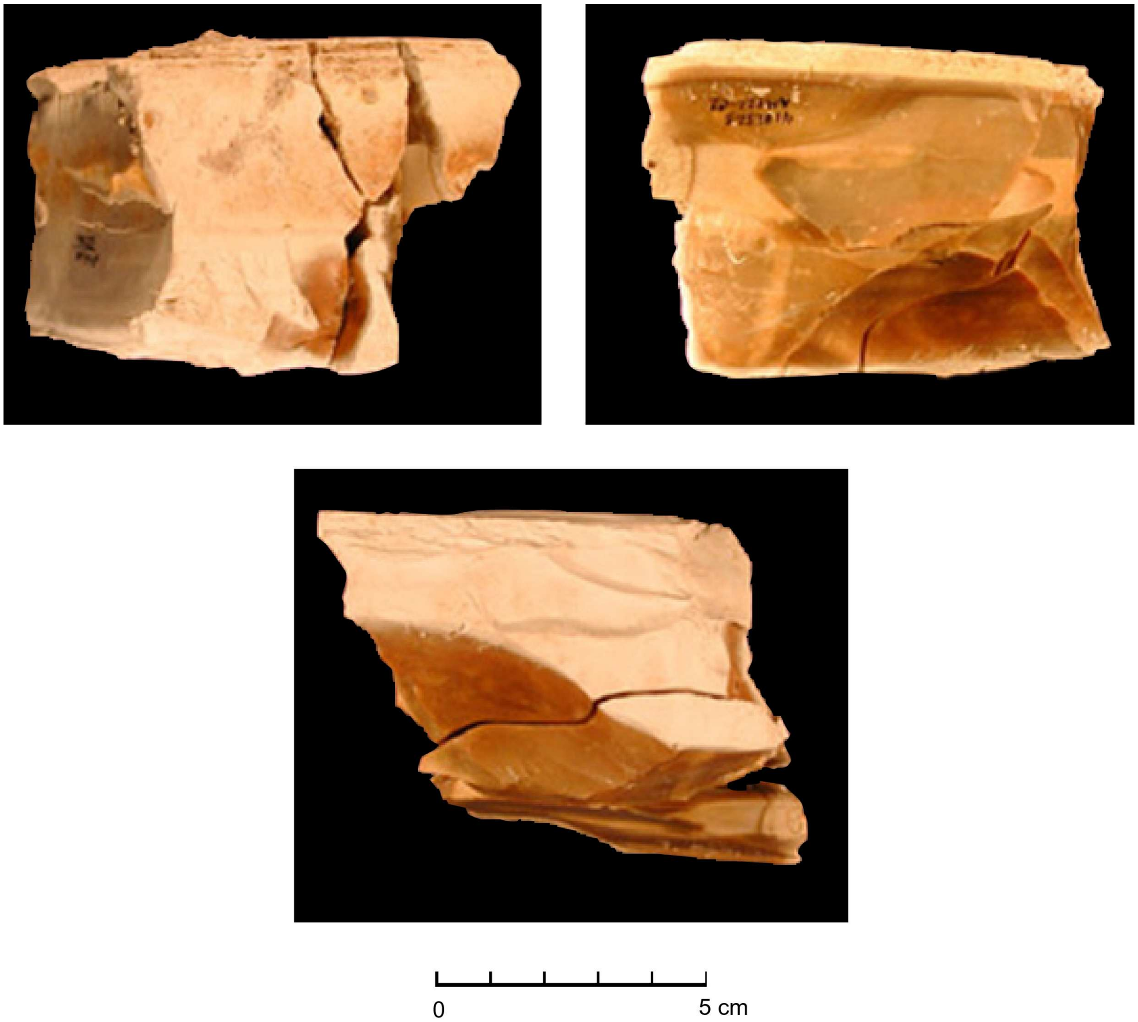


Figure 22. Refit group 5.

Refit group 29 is notable for its apparent difference in material – a darker gray chert that may be associated with material described from Fort Hood (C. Pevny, personal communication 2006). The sequential pieces consist of a complete flake, possibly edge modified, from the central area of the artifact concentration (excavation unit N1017 E983) rejoined with the distal portion of a cortical blade recorded approximately 2.0 m distant, at the northern extent of the concentration area.

Group 15 is shown in Figure 23. It consists of a whole flake that rejoins with two fragments of shatter, it is categorized as a sequential refit based on the fact that the piece broke apart during the reduction process. The maximum vertical difference between any of the pieces measured 0.5 cm, however the horizontal distance measured 1.6 m.

Figure 23. Refit group 15.

Refit Groups from Geological Unit 3a and Transition 3a/3b

Figure 24 shows refit group 3 that contains 4 artifacts, four complete flakes that sequential fit to a small core. Notably, it is the first flake in sequence that was recovered from the higher elevation and geologic unit 3a/3b, albeit from screen and not point-provenienced. Three of the pieces were recovered from the same excavation unit: the core and second sequential flake from the same 5 cm excavation level; the third flake was also recovered from the screen but from the excavation unit adjacent and to the north. Maximum distances are estimated to be 5 cm vertical and 1 m horizontal.

Group 12 (see Figure 25) is a sequential refit of two large cortical flakes categorized as core clean-up flakes (Dickens 2005). The maximum vertical distance measured 4 cm and the horizontal distance measured 1.6 m.

Group 32 consists of two fragments that refit to form a non-cortical stage IV biface that snapped during end-thinning (see Figure 26). The difference in vertical elevation measured 2 cm, while the horizontal difference measured 2.25 m.

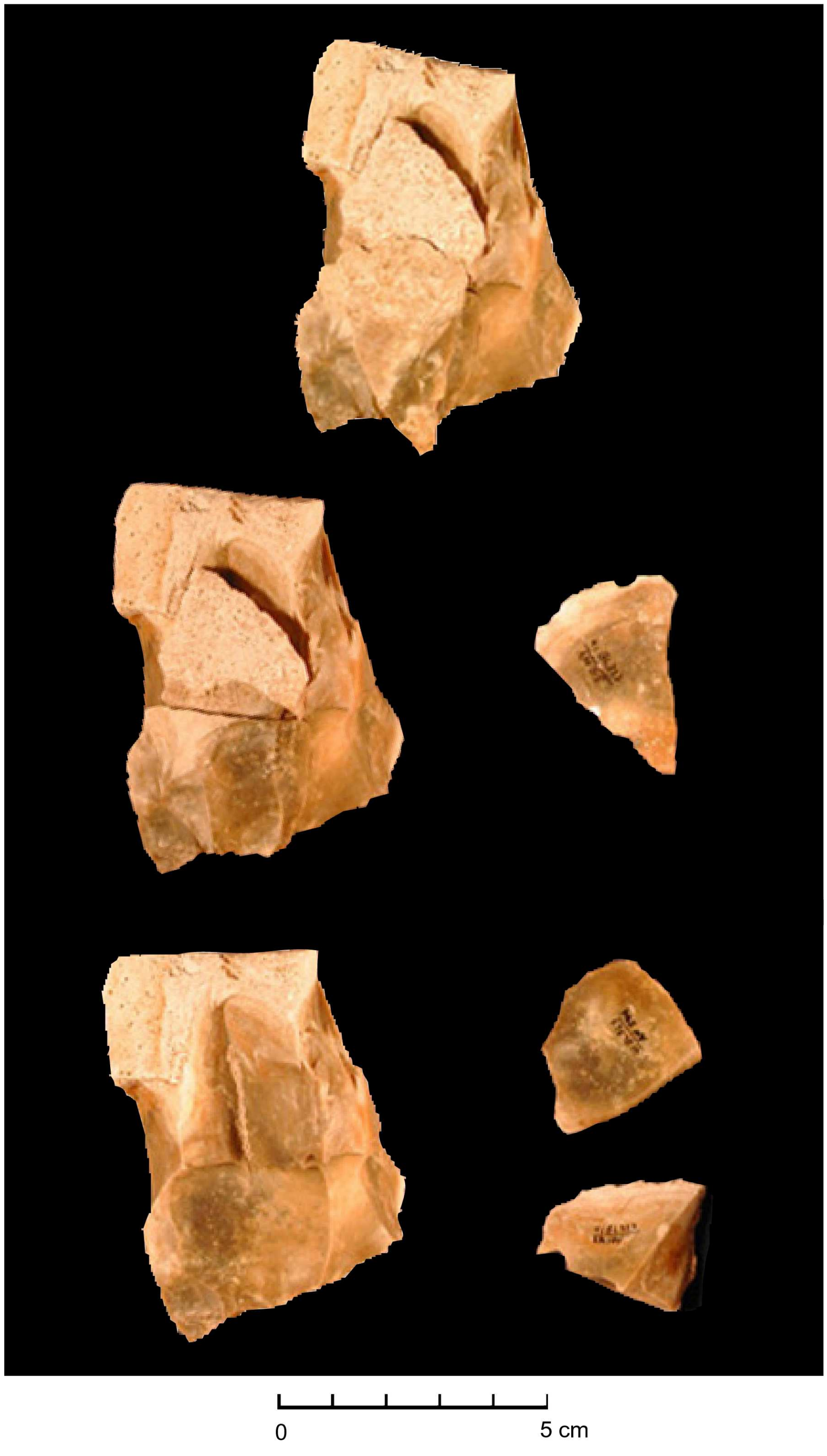


Figure 24. Refit group 3.

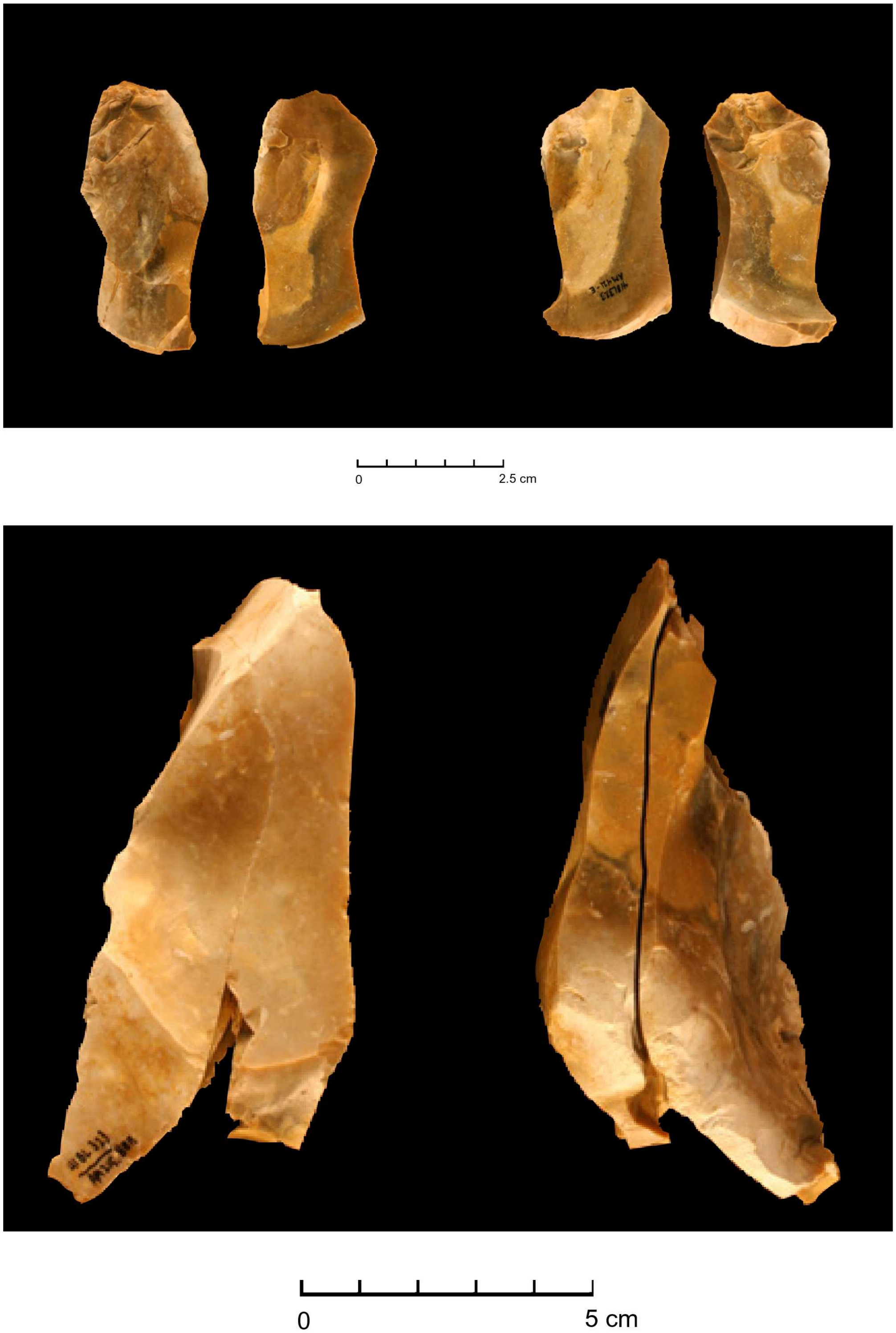


Figure 25. Refit group 12.

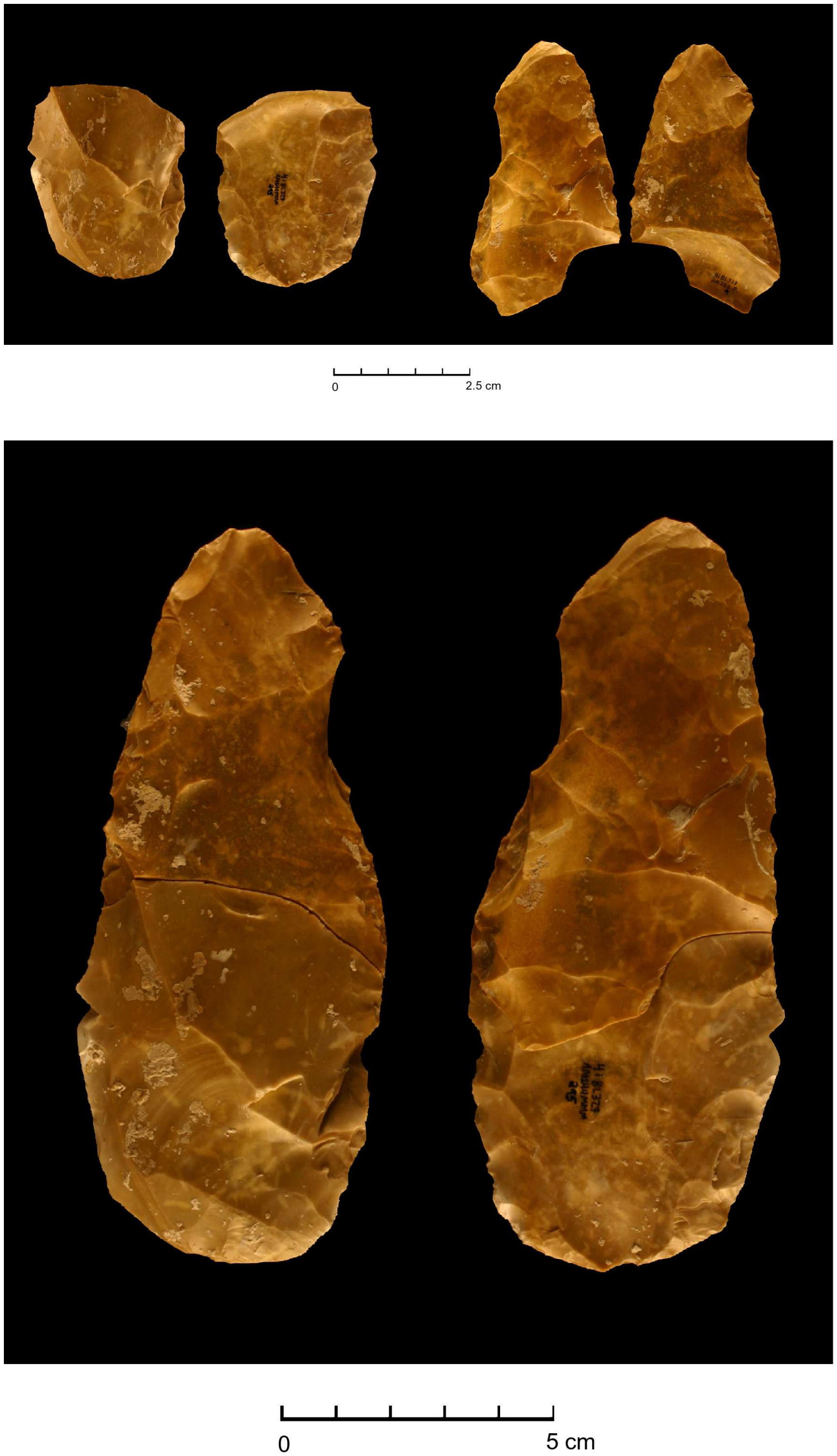


Figure 26. Refit group 32.

Refit Groups from Geological Unit 3b and Transition 3a/3b

Refit group 10 was the only group identified with elements in unit 3b and the transitional unit. It is a combination of three elements representing both categories of fit. The distal and proximal fragments of a cortical flake sequentially join with a complete cortical flake (see Figure 27). One fragment (AM 247.G) was recovered from unit 3b; while its proximal partner and the whole flake were recovered from the same excavation unit and level assigned to the transitional unit 3a/3b. The maximum horizontal distance measured 1.12 m; maximum vertical separation measured 5.5 cm.

Figure 27. Refit group 10.

Conclusions

The refit study indicates that the archaeological record of units 3a and 3b, the Clovis clays, retained a high degree of contextual integrity. All refit groups were contained within the Clovis cultural levels. One other group was a geofact whose two fragments were recovered from the underlying channel deposit, unit 2.

Within the Clovis-age deposits, the maximum vertical distance between refitting artifacts measured 20 cm. Instances of vertical displacement are represented by 5 of 28 refit groups that appear to cross units 3a and 3b (17 percent). The 5 groups with elements recovered from the transitional unit 3a/3b, where a clear contact between the units could not be discerned, are potentially groups that cross units. However, since the location of these refit groups is equivocal, they were excluded from these tabulations. The artifacts contained in the groups crossing units 3a and 3b are variable in type, size, and weight. No apparent trends such as smaller-refit artifacts moving upward, downward, or laterally, were discerned that would indicate significant depositional or post-depositional displacement has occurred as the result of stream action, trampling, or burrowing animals. If Clovis people were walking over this surface or reusing materials, some dislocation of refitting artifacts would be expected.

High values of horizontal distance were observed in all of the groups crossing units 3a and 3b. However, this cannot be considered a dependent variable due to observations with equally high horizontal distances but small or zero vertical distances. With the exception of group 13, vertical distances within unit 3a measured less than 7 cm.

The majority of refit groups (n = 21; 64 percent) were recovered from unit 3a, and 4 of the 5 with elements in the transition zone have one or more element in 3a. Only two refit groups were identified in unit 3b and one group with elements in 3b and 3a/3b. Compared to the number of refits identified from 3a, the refit data lends support to the scenario where occupation activity decreased during the formation unit 3b.

Horizontal patterning was not the primary focus of this study but was examined for general trends. Initial indications of point-provenienced artifacts did not identify clear, horizontally discrete concentrations of refit groups within unit 3a. Larger values of horizontal separation are present in the units north of the 1018 line. The small number of refit groups identified from unit 3b limits conclusions to a very general level. The artifacts in these groups have small values of vertical and horizontal separation, indicating little displacement has occurred.

Finally, a variety of chipped stone artifact types are represented in the refit groups. The numbers of sequential refits compared with the fragments that conjoin are relatively equal (15 versus 18, respectively). Of the sequential refits, 4 groups consist of a core and flakes, 3 groups are overshot flakes, 1 group consists of refitting blades, and 7 groups comprise general flakes as one element of the group. Of the fragmented artifacts that conjoin, 6 are bifaces, 4 are overshot flakes, 2 are blades, and 6 are general flakes. The variable nature of refitting pieces and the limited number of pieces within refit groups supports a scenario where not just quarrying but also more generalized activities were taking place at this site.

CHAPTER V

SUMMARY

This geoarchaeological research provides essential information for understanding the natural and cultural layers that were the TAMU excavation block at the Gault site. The stratigraphic investigation provides the temporal and spatial framework in which the cultural materials can be organized. Clear stratigraphy does not allow us to assume the artifact and assemblage associations however. Artifact spatial analyses examined long axis orientations and artifact degree of dip to identify non-random patterns that would result from stream action. Vertical and horizontal relationships of refitting artifacts were examined to evaluate post-depositional displacement. The results of this research indicate the clays bearing Clovis materials retained a high degree of integrity such that the spatial patterns preserved in the archaeological record at this location are the result of cultural activities and not natural processes.

The stratigraphic record preserved a sequence of seven lithostratigraphic units deposited by the perennial Buttermilk Creek. These units comprised channel and point bar facies, overlain by finer-grained overbank sediments over the course of the last 11,000 calendar years, based on the oldest cultural materials recovered from the excavation block – fluted points, blades, and overshot flakes diagnostic of the Clovis period (Waters and Stafford 2007). Located at the margin of the stream valley, colluvial materials interfinger with the alluvial units. A distinct buried soil was identified capping the alluvium bearing more recent Paleoindian Folsom and Angostura points, which serves as a marker horizon that is regionally correlated to the Brown (Gibson 1997) and Royalty (Nordt 1992, 1995) paleosol. Luchsinger (2002) confirmed in micromorphological analysis that the contact between 3a and 3b is a second buried soil that is less distinct in appearance, having been obscured by microbiological activity. The unconformable contact between units 3b and 4b represents a period of erosion in which we don't know the amount of material that may have been removed when 3b was truncated. Artifact orientation analyses were completed to identify the influence of stream action on artifact spatial patterns.

The orientation analyses did not find non-random spatial patterns in long-axis orientations (strike) or artifact degree of inclination (dip). Minor preferred orientations and trends in dip followed the site-specific paleotopography represented in the stratigraphy. Artifacts in unit 3b showed a significant difference in degree of dip when compared to the artifacts in unit 3a, although the difference was small (30 versus 28 degrees). A small easterly channel is represented by vertical distribution of dipped artifacts in the southern area of the excavation block (N1017, E982-986). The dip values are random, however, not imbricated.

A study of refitting artifacts was completed to evaluate post-depositional vertical displacement and look for horizontally discrete concentrations. Thirty-three groups of refitting artifacts were identified for use in the tabulations. With approximately 66,000 artifacts in the unit 3a and 3b assemblage, the refits are a mere fraction (0.1 percent). Sequential and fragmented refit types were found in nearly equal numbers. Artifact types varied from bifaces (including a Stage VI fluted preform), overshot flakes, blades, flakes, and cores. Only two groups were recovered unequivocally from unit 3b, while the majority of refit groups are associated with unit 3a. Of 28 refit groups unequivocally associated with unit 3 and 3b, 5 contain elements that appear to come from both units 3a and 3b. The maximum vertical distance between refits measured 20 cm, although 67 percent of the thirty-three groups measured a maximum vertical separation of 6 cm or less. Few refits were recovered from unit 3b, preventing any conclusive results of horizontal spatial patterns beyond the fact that these refitting pieces are less horizontally distant than refit artifacts in unit 3a. Refitting artifacts in unit 3a were found up to 2.8 m distant. The artifacts from this refit group measured zero vertical distance however, thus horizontal distance is not necessarily correlated with vertical distance.

Geoarchaeological studies such as these provide important information that is necessary for archaeologists to develop accurate and comprehensive interpretations of the archaeological record. The geomorphic landscape and associated depositional environments of a site are derived from traditional stratigraphic investigations, and serve to broaden our understanding of cultural behaviors as they relate to their environmental context. Though time-consuming in the field and laboratory, additional fine-grained analyses such as the artifact orientation and refit studies reported here provide separate lines of evidence to account for natural processes that may have acted to obscure the original patterns of the archaeological record, and our understanding of past human cultures.

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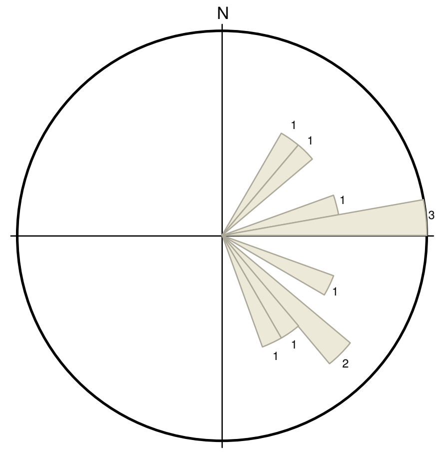
APPENDIX A

ARTIFACT ORIENTATION DATA

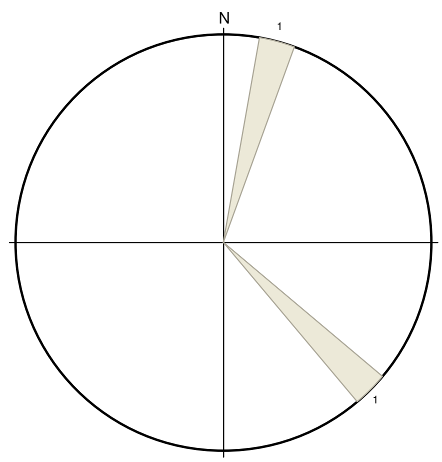
The following rose diagrams are unidirectional, with 36 classes of 10° intervals.

Long Axis Orientation Rose Diagrams and Statistics for Each Unit in Geologic Unit 3b.

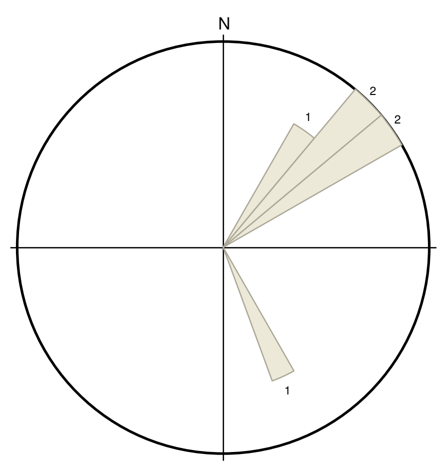
N1015 E982
Number of Points: 11
Maximum Class: 27%
Vector Mean (Compass Direction): 103.05 (SE)
Angular Deviation: ± 35.91
Vector Magnitude: 8.84
Consistency Ratio: 0.8036



N1015 E984
Number of Points: 2
Maximum Class: 50%
Vector Mean (Compass Direction): 75.00 (NE)
Angular Deviation: ± 54.68
Vector Magnitude: 1.09
Consistency Ratio: 0.5446



N1016 E982
Number of Points: 7
Maximum Class: 29%
Vector Mean (Compass Direction): 49.28 (NE)
Angular Deviation: ± 40.67
Vector Magnitude: 5.24
Consistency Ratio: 0.7481



N1016 E983
Number of Points: 4
Maximum Class: 50%
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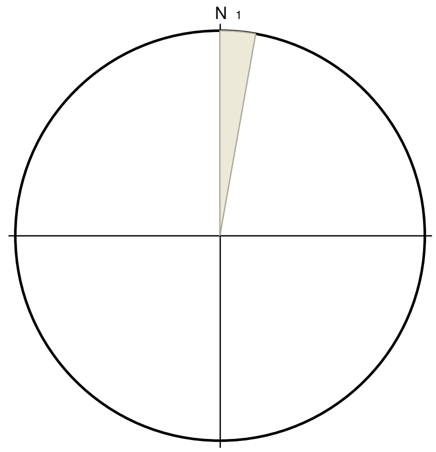
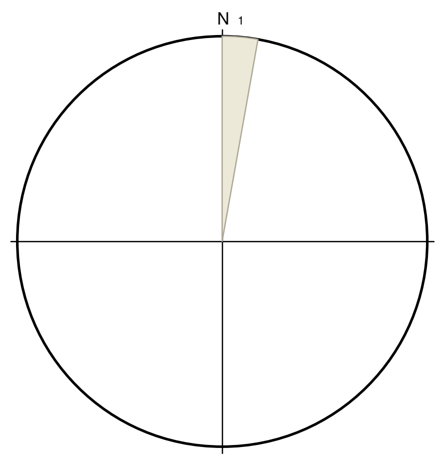
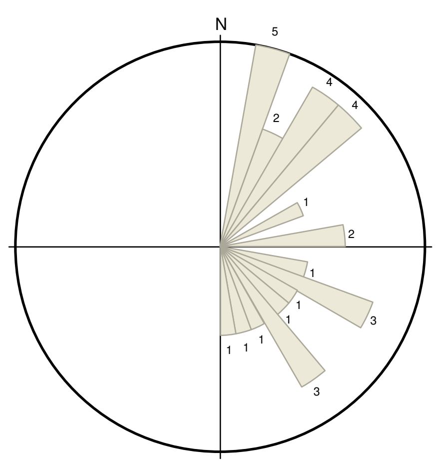
Angular Deviation: ± 21.87
Vector Magnitude: 3.71
Consistency Ratio: 0.9272



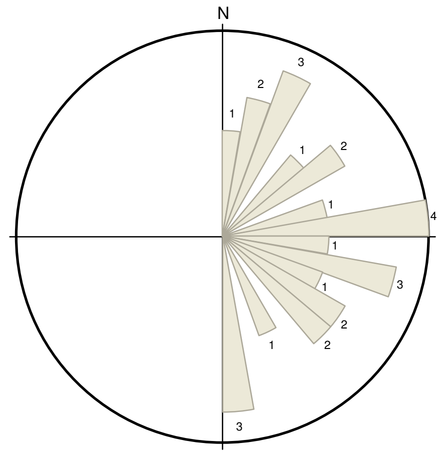
N1016 E984
Number of Points: 1
Maximum Class: 100%
Vector Mean (Compass Direction): 4.00 (N)
Angular Deviation: ± 0.00
Vector Magnitude: 1.00
Consistency Ratio: 1.0000



N1017 E982
Number of Points: 31
Maximum Class: 16%
Vector Mean (Compass Direction): 71.34 (NE)
Angular Deviation: ± 50.73
Vector Magnitude: 18.85
Consistency Ratio: 0.6081



N1017 E983
Number of Points: 27
Maximum Class: 15%
Vector Mean (Compass Direction): 91.08 (E)
Angular Deviation: ± 48.30
Vector Magnitude: 17.41
Consistency Ratio: 0.6448



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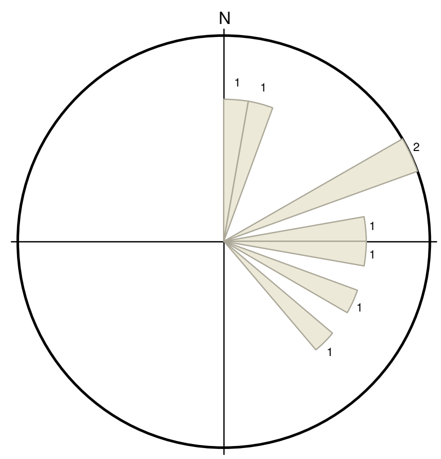
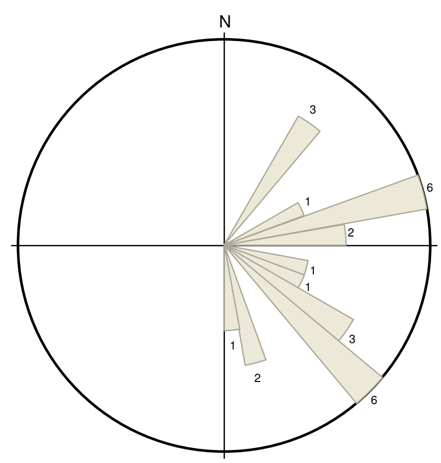
Number of Points: 8
Maximum Class: 25%
Vector Mean (Compass Direction): 76.52 (NE)
Angular Deviation: ± 39.92
Vector Magnitude: 6.06
Consistency Ratio: 0.7573



N1017 E985
Number of Points: 26
Maximum Class: 23%
Vector Mean (Compass Direction): 107.25 (SE)
Angular Deviation: ± 39.04
Vector Magnitude: 19.96
Consistency Ratio: 0.7678



N1017 E986
Number of Points: 3
Maximum Class: 33%
Vector Mean (Compass Direction): 73.08 (NE)
Angular Deviation: ± 41.61
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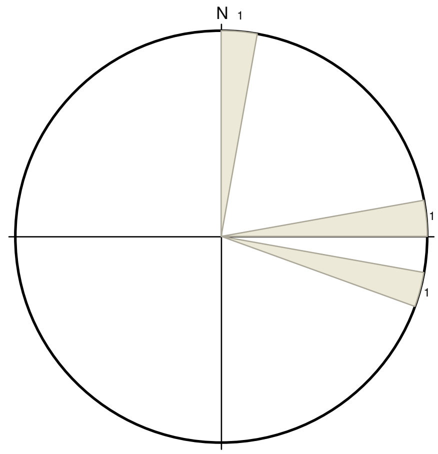
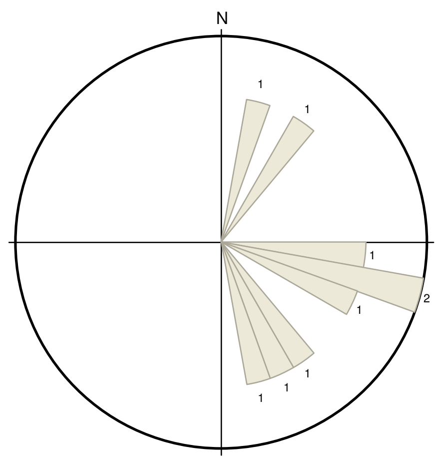
Consistency Ratio: 0.7363



N1018 E982
Number of Points: 41
Maximum Class: 15%
Vector Mean (Compass Direction): 80.37 (NE)
Angular Deviation: ± 44.52
Vector Magnitude: 28.62
Consistency Ratio: 0.6981



N1018 E983
Number of Points: 10
Maximum Class: 20%
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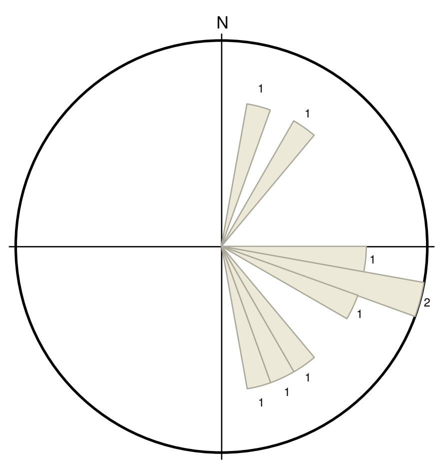
Angular Deviation: ± 51.06
Vector Magnitude: 6.03
Consistency Ratio: 0.6029



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Vector Mean (Compass Direction): 86.55 (E)
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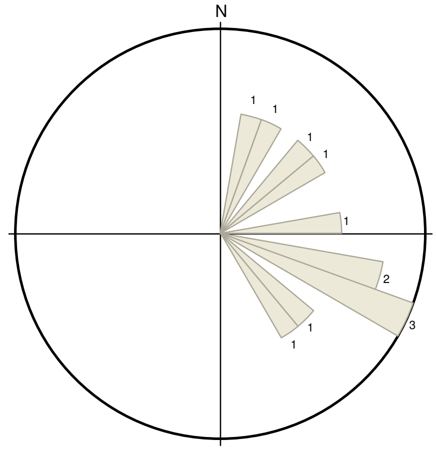
Vector Magnitude: 9.17
Consistency Ratio: 0.7052



N1019 E982
Number of Points: 4
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Vector Mean (Compass Direction): 67.72 (NE)
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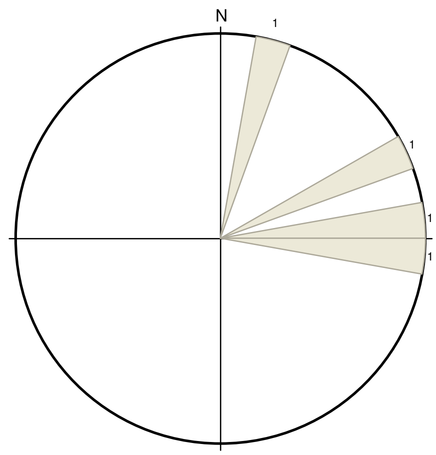
Consistency Ratio: 0.8728



N1019 E983
Number of Points: 16
Maximum Class: 19%
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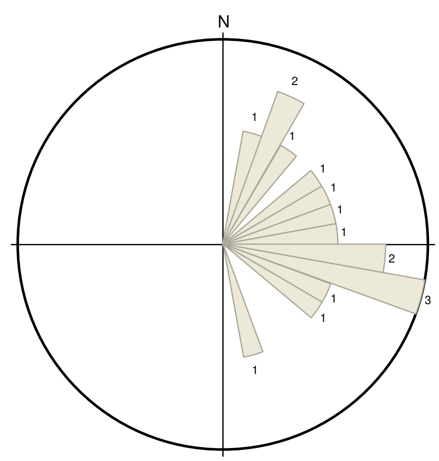
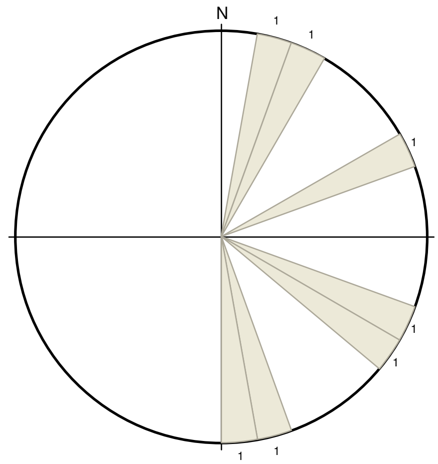
Angular Deviation: ± 38.87
Vector Magnitude: 12.32
Consistency Ratio: 0.7699



N1020 E982
Number of Points: 8
Maximum Class: 12%
Vector Mean (Compass Direction): 86.51 (E)
Angular Deviation: ± 59.23
Vector Magnitude: 3.73
Consistency Ratio: 0.4657



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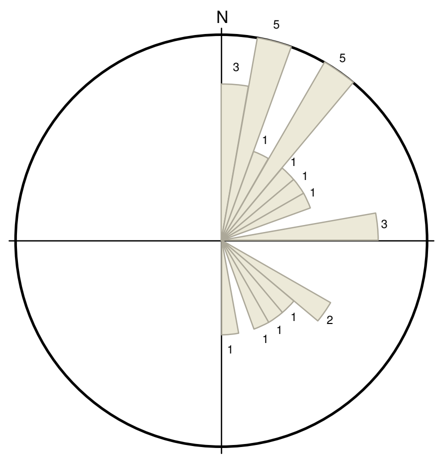

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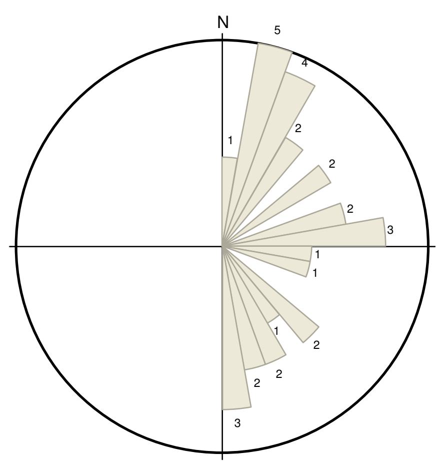

N1021 E983

Number of Points:	28
Maximum Class:	14%
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Vector Magnitude:	19.51
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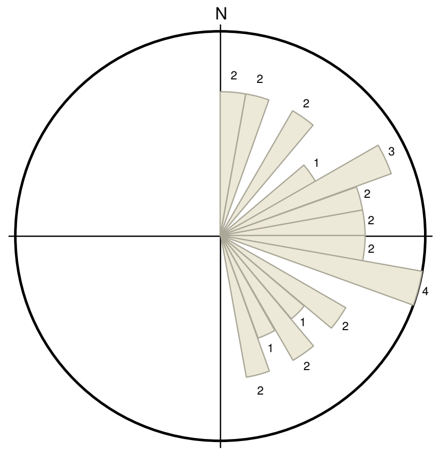
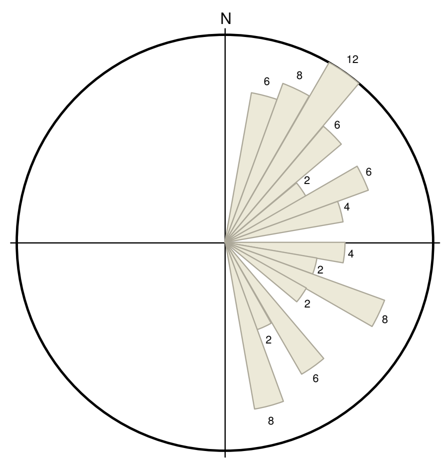


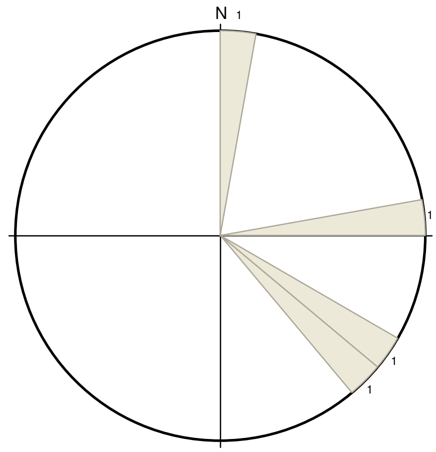
N1021 E984

Number of Points:	39
Maximum Class:	15%
Vector Mean (Compass Direction):	75.08 (NE)
Angular Deviation:	± 48.42
Vector Magnitude:	25.08
Consistency Ratio:	0.6430

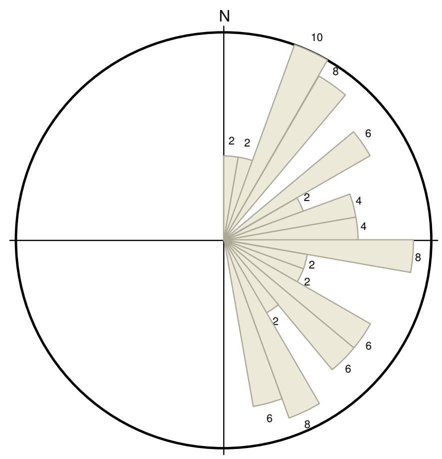


Long Axis Orientation Rose Diagrams and Statistics for Each Unit in Geologic Unit 3a.

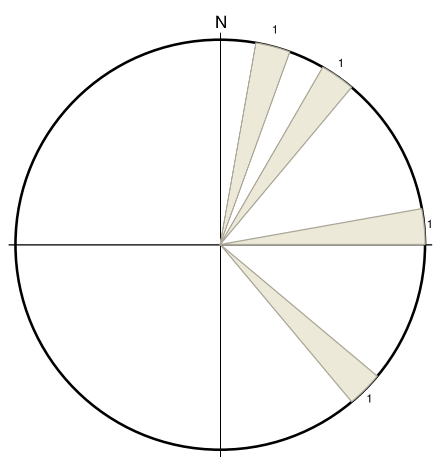
N1015 E982
Number of Points: 4
Maximum Class: 25%
Vector Mean (Compass Direction): 95.63 ( )
Angular Deviation: ± 48.01
Vector Magnitude: 2.60
Consistency Ratio: 0.6489



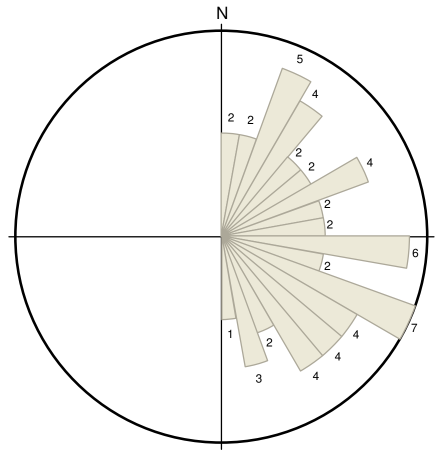
N1016 E982
Number of Points: 40
Maximum Class: 12%
Vector Mean (Compass Direction): 88.28 (E)
Angular Deviation: ± 49.47
Vector Magnitude: 25.09
Consistency Ratio: 0.6273



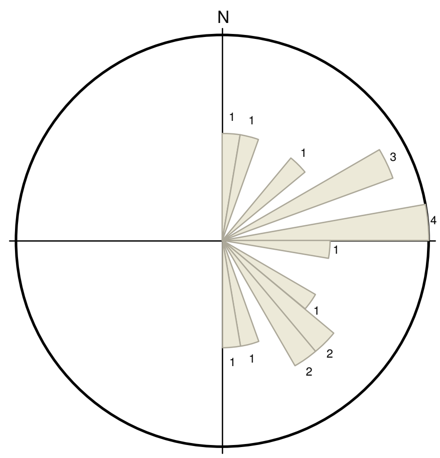
N1016 E983
Number of Points: 4
Maximum Class: 25%
Vector Mean (Compass Direction): 67.17 (NE)
Angular Deviation: ± 45.81
Vector Magnitude: 2.72
Consistency Ratio: 0.6803



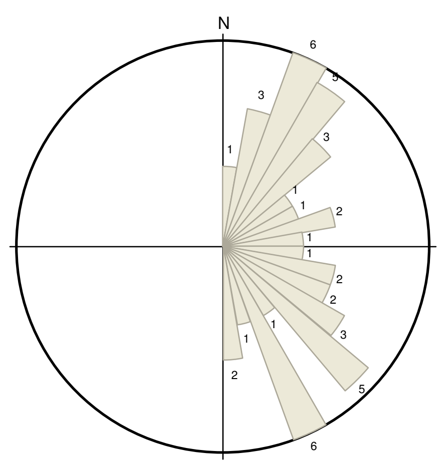
N1017 E983
Number of Points: 58
Maximum Class: 12%
Vector Mean (Compass Direction): 93.61 (E)
Angular Deviation: ± 45.23
Vector Magnitude: 39.93
Consistency Ratio: 0.6885



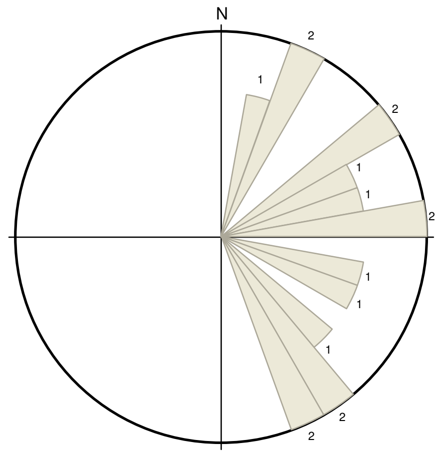
N1017 E984
Number of Points: 18
Maximum Class: 22%
Vector Mean (Compass Direction): 101.35 (SE)
Angular Deviation: ± 44.56
Vector Magnitude: 12.56
Consistency Ratio: 0.6976



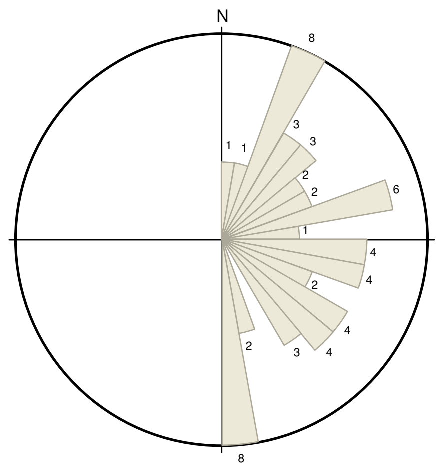
N1017 E985
Number of Points: 47
Maximum Class: 13%
Vector Mean (Compass Direction): 87.04 (E)
Angular Deviation: ± 52.54
Vector Magnitude: 27.24
Consistency Ratio: 0.5795



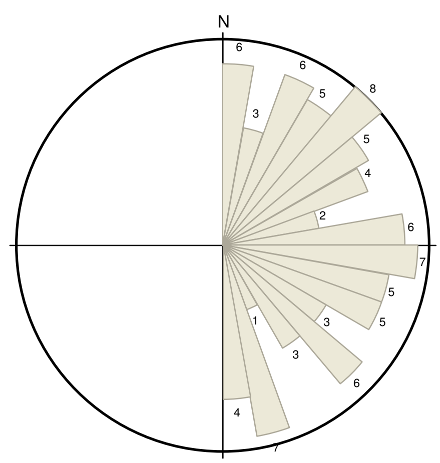
N1017 E986
Number of Points: 16
Maximum Class: 12%
Vector Mean (Compass Direction): 91.19 (E)
Angular Deviation: ± 45.69
Vector Magnitude: 10.91
Consistency Ratio: 0.6821



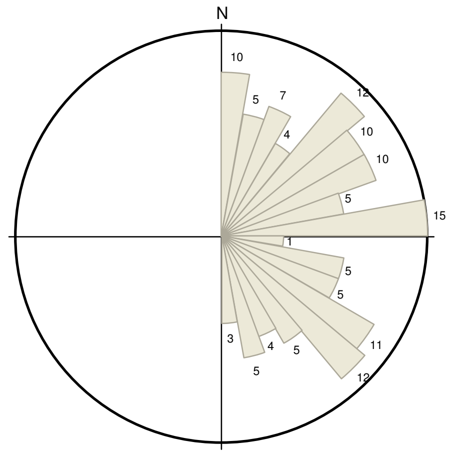
N1018 E982
Number of Points: 58
Maximum Class: 14%
Vector Mean (Compass Direction): 95.73 ( )
Angular Deviation: ± 48.75
Vector Magnitude: 37.00
Consistency Ratio: 0.6380



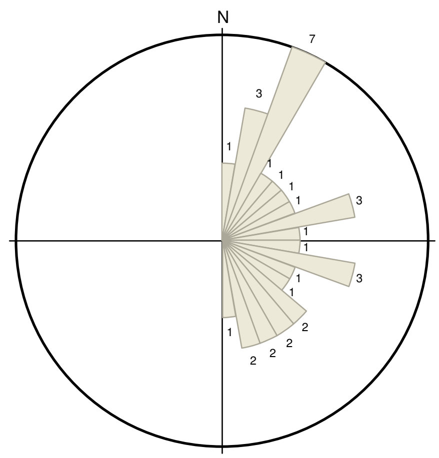
N1018 E983
Number of Points: 87
Maximum Class: 9%
Vector Mean (Compass Direction): 86.11 (E)
Angular Deviation: ± 48.90
Vector Magnitude: 55.31
Consistency Ratio: 0.6357



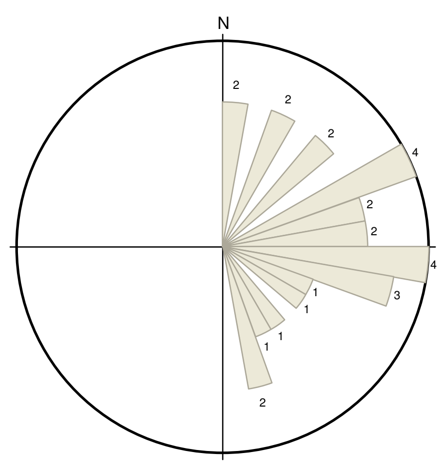
N1018 E984
Number of Points: 137
Maximum Class: 11%
Vector Mean (Compass Direction): 83.66 (NE)
Angular Deviation: ± 47.17
Vector Magnitude: 90.58
Consistency Ratio: 0.6612



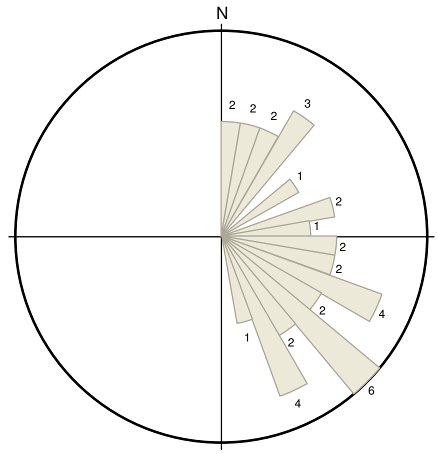
N1019 E982
Number of Points: 34
Maximum Class: 21%
Vector Mean (Compass Direction): 80.12 (NE)
Angular Deviation: ± 50.56
Vector Magnitude: 20.76
Consistency Ratio: 0.6107



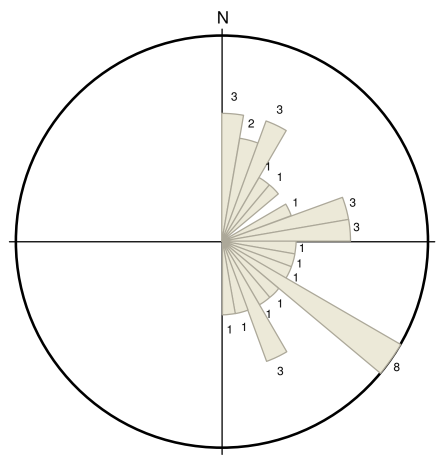
N1019 E983
Number of Points: 29
Maximum Class: 14%
Vector Mean (Compass Direction): 79.85 (NE)
Angular Deviation: ± 44.96
Vector Magnitude: 20.07
Consistency Ratio: 0.6922



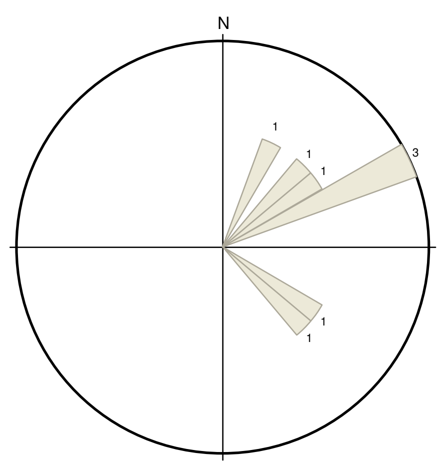
N1020 E982
Number of Points: 37
Maximum Class: 16%
Vector Mean (Compass Direction): 99.92 (SE)
Angular Deviation: ± 47.94
Vector Magnitude: 24.05
Consistency Ratio: 0.6500



N1020 E983
Number of Points: 35
Maximum Class: 23%
Vector Mean (Compass Direction): 94.51 (E)
Angular Deviation: ± 49.06
Vector Magnitude: 22.17
Consistency Ratio: 0.6334



N1020 E984
Number of Points: 8
Maximum Class: 38%
Vector Mean (Compass Direction): 73.55 (NE)
Angular Deviation: ± 35.70
Vector Magnitude: 6.45
Consistency Ratio: 0.8059



N1021 E984
Number of Points: 1
Maximum Class: 100%
Vector Mean (Compass Direction): 132.00 (SE)
Angular Deviation: ± 0.00
Vector Magnitude: 1.00
Consistency Ratio: 1.0000

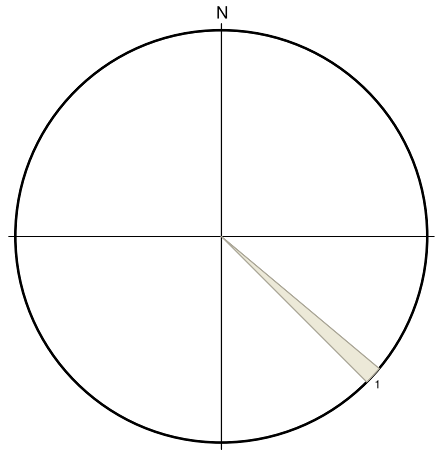


Table A-1. Artifact Orientation Data Unit 3b

Sack	Sub Sack	Field Rec	Northing	Easting	Elevation	Strike	Adj Strike	Group Code	Dip	Dir	Dir Code
0185	A	1	1015.38	982.18	95.35	90	90	1	22	N	1
0185	B	2	1015.40	982.27	95.32	90	90	1	4	E	2
0158	B	2	1015.45	982.30	95.40	330	150	1	32	E	2
0220		4	1015.54	982.78	95.23	226	46	1	48	NW	4
0220		5	1015.54	982.83	95.22	260	80	1	13	S	3
0220	B	3	1015.56	982.75	95.25	332	152	1	22	W	4
0220		2	1015.57	982.74	95.24	132	132	1	20	N	1
0158	A	1	1015.60	982.30	95.41	40	40	1	34	E	2
0239	C	1	1015.74	982.73	95.22	298	118	1	36	S	3
0220	A	1	1015.78	982.65	95.26	318	138	1	20	NE	1
0185	C	3	1015.97	982.56	95.36	90	90	1	18	E	2
0218		0	1015.68	984.03	95.22	312	132	1	38	S	3
0212		1	1015.82	984.40	95.23	18	18	1	31	W	4
0211	G	6	1016.00	982.43	95.28	224	44	1	28	N	1
0211		5	1016.02	982.48	95.29	0	0	1	36	N	1
0204		1	1016.11	982.22	95.35	52	52	1	13	SE	2
0211	E	4	1016.72	982.12	95.32	340	160	1	42	N	1
0211	B	2	1016.84	982.62	95.32	50	50	1	28	W	4
0211	D	3	1016.91	982.16	95.32	58	58	1	32	N	1
0211	A	1	1016.91	982.64	95.32	32	32	1	32	E	2
0216	B	2	1016.82	983.70	95.27	288	108	1	36	E	2
0216	M	1	1016.97	983.62	95.25	332	152	1	60	E	2
0232		1	1016.45	984.27	95.15	184	4	1	45	SW	3
0285	J2	20	1017.05	982.3	95.15	172	172	2	74	E	2
0285	K2	21	1017.08	982.66	95.13	315	135	2	10	W	4
0241		2	1017.11	982.52	95.22	117	117	2	35	SW	3
0285	L2	24	1017.12	982.02	95.17	192	12	2	32	S	3
0274	P	3	1017.12	982.10	95.20	82	82	2	37	W	4
0285	I2	19	1017.12	982.19	95.12	216	36	2	10	S	3
0285	G2	17	1017.19	982.86	95.15	210	30	2	38	W	4
0285	H2	18	1017.2	982.38	95.13	32	32	2	14	N	1
0285	M2	25	1017.22	982.02	95.17	0	0	2	8	N	1
0274	Q	4	1017.24	982.19	95.19	322	142	2	22	NE	1
0285	D2	15	1017.27	982.97	95.17	346	166	2	46	S	3
0285	C2	14	1017.3	982.6	95.12	300	120	2	4	E	2
0285	V	12	1017.47	982.48	95.14	196	16	2	34	S	3
0285	U	11	1017.53	982.83	95.15	322	142	2	22	W	4
0274		2	1017.56	982.22	95.17	330	150	2	11	NE	1
0241		1	1017.57	982.28	95.22	112	112	2	3	NE	1
0285	S	10	1017.62	982.98	95.14	192	12	2	38	N	1
0285	R	9	1017.66	982.33	95.14	246	66	2	12	NE	1
0285	Q	8	1017.67	982.44	95.12	194	14	2	52	E	2
0285	L	5	1017.72	982.72	95.12	202	22	2	8	NW	4
0274		5	1017.73	982.23	95.17	50	50	2	25	NW	4
0285	O	1	1017.73	982.23	95.17	50	50	2	25	NW	4
0285	P	7	1017.76	982.19	95.12	110	110	2	14	W	4
0285	N	6	1017.77	982.55	95.12	218	38	2	4	SE	2
0285	I	4	1017.83	982.94	95.17	262	82	2	18	E	2
0285	E	16	1017.86	982.4	95.15	128	128	2	20	S	3

Table A-1. Continued.

Sack	Sub Sack	Field Rec	Northing	Easting	Elevation	Strike	Adj Strike	Group Code	Dip	Dir	Dir Code
0285	F	22	1017.86	982.46	95.17	214	34	2	38	W	4
0285	C	3	1017.87	982.05	95.12	42	42	2	32	SE	2
0274		1	1017.92	982.12	95.18	334	154	2	24	SW	3
0285	B	2	1017.92	982.28	95.17	16	16	2	3	S	3
0285	G	1	1017.95	982.63	95.16	226	46	2	36	N	1
0187	G	7	1017.06	983.02	95.31	280	100	2	28	W	4
0187			1017.08	983.38	95.32	60	60	2	16	S	3
0227		3	1017.11	983.75	95.23	260	80	2	80	S	3
0196		6	1017.13	983.42	95.25	50	50	2	36	E	2
0187	F	6	1017.22	983.79	95.30	356	176	2	32	W	4
0196	F	7	1017.28	983.73	95.24	354	174	2	26	N	1
0187	E	5	1017.34	983.58	95.30	90	90	2	22	E	2
0196		8	1017.44	983.63	95.25	340	160	2	34	S	3
0196	G	5	1017.48	983.42	95.25	24	24	2	62	S	3
0231		3	1017.49	983.35	95.14	320	140	2	9	NE	1
0196		4	1017.51	983.23	95.25	90	90	2	34	S	3
0196	A	1	1017.55	983.09	95.22	4	4	2	32	E	2
0227		1	1017.62	983.23	95.18	290	110	2	45	S	3
0231		2	1017.68	983.15	95.15	358	178	2	38	W	4
0187	D	4	1017.69	983.51	95.32	24	24	2	26	W	4
0196	E	10	1017.74	983.48	95.27	270	90	2	40	W	4
0187	C	3	1017.75	983.61	95.33	24	24	2	28	E	2
0196	D	9	1017.77	983.47	95.27	300	120	2	40	W	4
0187			1017.78	983.09	95.32	288	108	2	22	S	3
0187	B	2	1017.81	983.65	95.30	54	54	2	28	E	2
0227		2	1017.86	983.27	95.19	318	138	2	20	SE	2
0196		2	1017.90	983.05	95.25	302	122	2	38	N	1
0196	B	11	1017.90	983.39	95.25	12	12	2	22	S	3
0187			1017.95	983.28	95.32	102	102	2	50	W	4
0196	C	12	1017.95	983.50	95.25	264	84	2	44	N	1
0231		1	1017.97	983.17	95.19	302	122	2	34	NW	4
0227		4	1017.98	983.09	95.22	12	12	2	9	S	3
0178	B	2	1017.08	984.38	95.26	70	70	2	22	N	1
0178	A	1	1017.13	984.60	95.26	70	70	2	52	S	3
0178	C	3	1017.22	984.08	95.22	20	20	2	28	E	2
0170	C	3	1017.27	984.76	95.27	274	94	2	30	S	3
0170	A	1	1017.50	984.20	95.27	300	120	2	36	W	4
0178	D	4	1017.65	984.23	95.27	262	82	2	46	S	3
0178	E	5	1017.68	984.57	95.24	140	140	2	16	N	1
0170	B	2	1017.75	984.77	95.27	10	10	2	22	S	3
0157	A	1	1017.03	985.28	95.28	305	125	5	22	E	2
0209		8	1017.03	985.44	95.20	260	80	5	xx	xx	
0209		7	1017.03	985.69	95.20	318	138	5	12	NW	4
0209		9	1017.04	985.41	95.19	38	38	5	52	N	1
0157	B	2	1017.08	985.41	95.26	125	125	5	25	E	2
0217	G	2	1017.12	985.16	95.13	120	120	5	4	W	4
0209	D	3	1017.13	985.00	95.20	310	130	5	28	N	1
0223	F	1	1017.16	985.31	95.08	76	76	5	8	W	4
0209	C	2	1017.21	985.09	95.21	262	82	5	30	W	4
0157	C	3	1017.27	985.61	95.26	140	140	5	40	N	1

Table A-1. Continued.

Sack	Sub Sack	Field Rec	Northing	Easting	Elevation	Strike	Adj Strike	Group Code	Dip	Dir	Dir Code
0209		4	1017.35	985.13	95.19	350	170	5	42	N	1
0223	G	2	1017.52	985.23	95.13	110	110	5	26	W	4
0209		5	1017.55	985.11	95.21	258	78	5	18	NW	4
0157	G	7	1017.55	985.33	95.22	170	170	5	24	W	4
0209		6	1017.61	985.07	95.19	320	140	5	47	NW	4
0157	D	4	1017.62	985.82	95.29	140	140	5	83	E	2
0223	H	3	1017.64	985.13	95.09	136	136	5	36	SE	2
0223	I	4	1017.68	985.00	95.13	34	34	5	62	N	1
0157	F	6	1017.77	985.24	95.25	320	140	5	2	N	1
0217	H	5	1017.80	985.21	95.14	76	76	5	48	E	2
0157	E	5	1017.81	985.70	95.25	90	90	5	8	W	4
0217	D	4	1017.82	985.12	95.14	64	64	5	16	W	4
0223	K	5	1017.82	985.50	95.13	180	180	5	56	N	1
0209	A	1	1017.83	985.23	95.21	78	78	5	41	S	3
0217	C	3	1017.87	985.02	95.18	40	40	5	42	W	4
0157	H	8	1017.17	985.96	95.29	80	80	5	30	E	2
0210	F	2	1017.16	986.19	95.19	270	90	5	25	E	2
0210	E	1	1017.30	986.67	95.20	10	10	5	22	N	1
0207		1	1017.42	986.10	95.24	290	110	5	10	E	2
0247	A	1	1018.05	982.01	95.24	46	46	2	52	N	1
0247	B	2	1018.06	982.04	95.24	30	30	2	32	N	1
0203	A	17	1018.08	982.27	95.25	300	120	2	24	W	4
0203		16	1018.09	982.42	95.27	284	104	2	34	W	4
0247	C	3	1018.10	982.14	95.24	80	80	2	38	E	2
0203		18	1018.10	982.34	95.27	20	20	2	8	S	3
0203		20	1018.14	982.16	95.24	304	124	2	14	W	4
0203	T	21	1018.14	982.73	95.24	324	144	2	42	E	2
0203	V	1	1018.18	982.90	95.26	120	120	2	4	SW	3
0203	B	15	1018.34	982.54	95.26	84	84	2	20	SE	2
0247	D	4	1018.34	982.79	95.17	38	38	2	22	S	3
0203		19	1018.36	982.76	95.26	60	60	2	31	W	4
0247	E	5	1018.37	982.76	95.17	326	146	2	28	NW	4
0247	F	6	1018.39	982.10	95.17	20	20	2	12	S	3
0203		13	1018.44	982.12	95.24	20	20	2	6	W	4
0203	M	12	1018.54	982.59	95.26	106	106	2	51	W	4
0203	N	11	1018.54	982.63	95.25	102	102	2	31	N	1
0203	T	6	1018.63	982.16	95.25	350	170	2	36	N	1
0193		5	1018.65	982.75	95.31	264	84	2	34	W	4
0193		2	1018.69	982.57	95.31	70	70	2	22	S	3
0203	L	9	1018.70	982.56	95.27	16	16	2	65	NE	1
0247		15	1018.72	982.89	95.17	306	126	2	32	SE	2
0203	C	5	1018.75	982.03	95.25	302	122	2	33	NW	4
0203	K	8	1018.76	982.62	95.26	336	156	2	78	N	1
0247	I	9	1018.79	982.87	95.18	330	150	2	12	S	3
0193		4	1018.79	982.91	95.29	270	90	2	20	S	3
0203	I	10	1018.80	982.55	95.27	20	20	2	29	N	1
0247	K	11	1018.81	982.92	95.17	0	0	2	20	N	1
0203	H	7	1018.85	982.36	95.23	84	84	2	33	E	2
0247	G	7	1018.85	982.48	95.17	288	108	2	16	W	4
0247	H	8	1018.85	982.85	95.19	280	100	2	16	W	4

Table A-1. Continued.

Sack	Sub Sack	Field Rec	Northing	Easting	Elevation	Strike	Adj Strike	Group Code	Dip	Dir	Dir Code
0203	D	4	1018.86	982.13	95.23	32	32	2	32	NE	1
0203	B2	2	1018.90	982.70	95.25	60	60	2	28	W	4
0247	N	14	1018.92	982.44	95.22	36	36	2	42	NE	1
0247	M	13	1018.92	982.53	95.22	16	16	2	0	horiz	5
0203	F	3	1018.94	982.33	95.23	86	86	2	18	E	2
0193		3	1018.94	982.92	95.28	256	76	2	54	N	1
0203	C2	1	1018.95	982.90	95.24	340	160	2	2	N	1
0247	L	12	1018.95	982.92	95.18	278	98	2	30	E	2
0247	J	10	1018.96	982.64	95.20	10	10	2	44	N	1
0193		1	1018.98	982.22	95.27	250	70	2	16	N	1
0419	A	1	1018.07	983.16	95.25	214	34	2	30	W	4
0417	B	2	1018.10	983.66	95.29	0	0	2	30	W	4
0420	F	4	1018.19	983.72	95.20	340	160	2	28	W	4
0420	B	1	1018.20	983.46	95.19	296	116	2	20	E	2
0420	E	3	1018.21	983.77	95.22	284	104	2	90	S	3
0417	A	1	1018.23	983.73	95.31	322	142	2	40	N	1
0419	B	2	1018.24	983.56	95.24	288	108	2	4	W	4
0419	C	3	1018.42	983.70	95.22	344	164	2	44	S	3
0420	G	5	1018.47	983.85	95.19	20	20	2	36	N	1
0420	C	2	1018.87	983.95	95.21	272	92	2	68	S	3
0296	B	2	1018.08	984.36	95.27	146	146	2	32	N	1
0296	A	1	1018.12	984.55	95.23	42	42	2	30	E	2
0303	B	1	1018.31	984.30	95.20	290	110	2	16	S	3
0312	C	3	1018.47	984.78	95.14	0	0	2	10	S	3
0303	H	3	1018.53	984.03	95.19	104	104	2	54	S	3
0312	A	1	1018.53	984.36	95.16	20	20	2	35	W	4
0303	J	5	1018.70	984.23	95.20	30	30	2	14	N	1
0303	I	4	1018.72	984.18	95.19	118	118	2	64	N	1
0312	B	2	1018.75	984.41	95.17	300	120	2	80	E	2
0303	K	6	1018.80	984.04	95.19	120	120	2	30	S	3
0303	L	7	1018.85	984.03	95.20	136	136	2	18	W	4
0303	M	8	1018.85	984.23	95.19	60	60	2	22	N	1
0303	G	2	1018.88	984.44	95.20	264	84	2	14	S	3
0156	A	1	1019.43	982.50	95.33	20	20	3	10	N	1
0175	B	2	1019.47	982.08	95.29	94	94	3	50	S	3
0179	A	1	1019.60	982.17	95.30	63	63	3	34	S	3
0182	F	1	1019.98	982.62	95.27	90	90	3	58	W	4
0205	H	9	1019.10	983.95	95.17	32	32	3	12	NW	4
0168	A	1	1019.16	983.62	95.27	120	120	3	20	N	1
0205	C	8	1019.18	983.65	95.19	65	65	3	10	NW	4
0188	A	1	1019.20	983.55	95.24	16	16	3	34	W	4
0205		10	1019.25	983.65	95.18	96	96	3	16	S	3
0205		11	1019.30	983.68	95.19	104	104	3	59	E	2
0205	E	6	1019.57	983.65	95.19	26	26	3	16	N	1
0205	F	12	1019.72	983.62	95.17	302	122	3	12	SE	2
0205		1	1019.85	983.10	95.22	272	92	3	38	S	3
0205		4	1019.86	983.55	95.22	290	110	3	40	N	1
0168	C	3	1019.90	983.15	95.30	24	24	3	6	N	1
0205		7	1019.90	983.45	95.22	346	166	3	84	W	4
0205		5	1019.90	983.50	95.22	270	90	3	18	S	3

Table A-1. Continued.

Sack	Sub Sack	Field Rec	Northing	Easting	Elevation	Strike	Adj Strike	Group Code	Dip	Dir	Dir Code
0205		2	1019.95	983.60	95.21	240	60	3	38	S	3
0205		3	1019.95	983.60	95.22	290	110	3	40	S	3
0168	B	2	1019.97	983.86	95.27	80	80	3	8	N	1
0192	C	2	1020.08	982.35	95.22	354	174	3	32	xx	
0192	N	1	1020.10	982.70	95.18	344	164	3	16	N	1
0173	B	2	1020.15	982.62	95.28	304	124	3	22	W	4
0173	C	3	1020.19	982.87	95.27	300	120	3	34	W	4
0186	A	1	1020.29	982.50	95.27	22	22	3	22	E	2
0186	D	1	1020.45	982.36	95.24	0	0	3	82	N	1
0173	D	4	1020.52	982.82	95.27	20	20	3	42	S	3
0186	F	2	1020.82	982.54	95.25	68	68	3	26	S	3
0175	A	1	1020.05	983.37	95.24	124	124	3	48	S	3
0246	R	14	1020.07	983.35	95.22	0	0	3	76	S	3
0246	S	13	1020.12	983.36	95.22	8	8	3	46	SE	2
0246	V	15	1020.12	983.53	95.23	38	38	3	12	SE	2
0246	P	12	1020.16	983.32	95.22	330	150	3	30	S	3
0246	X	17	1020.20	983.82	95.20	60	60	3	24	E	2
0246	O	11	1020.24	983.28	95.20	320	140	3	24	N	1
0246	Q	10	1020.25	983.42	95.20	354	174	3	4	S	3
0246	G2	16	1020.33	983.77	95.22	38	38	3	70	W	4
0246	N	9	1020.40	983.44	95.19	40	40	3	19	SE	2
0246	B	1	1020.41	983.08	95.23	14	14	3	52	W	4
0246	C	2	1020.46	983.05	95.23	90	90	3	40	W	4
0167	B	2	1020.50	983.65	95.31	22	22	3	40	N	1
0167	A	1	1020.52	983.12	95.32	4	4	3	2	N	1
0246		4	1020.53	983.00	95.22	14	14	3	10	N	1
0246	D	3	1020.53	983.00	95.22	90	90	3	42	W	4
0153	C	3	1020.53	983.47	0.00	50	50	3	10	E	2
0153	A	1	1020.55	983.78	0.00	20	20	3	38	W	4
0246	L	5	1020.58	983.32	95.23	304	124	3	22	W	4
0246	E2	18	1020.62	983.95	95.23	12	12	3	34	S	3
0179	C	1	1020.64	983.24	95.25	340	160	3	32	W	4
0246	J	8	1020.75	983.21	95.21	40	40	3	38	NW	4
0246	I	7	1020.80	983.23	95.21	4	4	3	6	S	3
0246	K	6	1020.82	983.35	95.22	84	84	3	52	W	4
0246	F2	20	1020.86	983.92	95.19	18	18	3	22	E	2
0153	D	4	1020.93	983.74	0.00	250	70	3	62	S	3
0153	B	2	1020.94	983.37	0.00	32	32	3	20	S	3
0291	S	7	1020.11	984.72	95.12	320	140	3	14	NE	1
0291	B3	28	1020.12	984.16	95.10	356	176	3	8	N	1
0291	N2	19	1020.13	984.39	95.11	270	90	3	30	E	2
0291	F2	14	1020.24	984.58	95.07	78	78	3	230	SW	3
0258	B	1	1020.25	984.09	95.14	318	138	3	42	NE	1
0291	Q2	20	1020.26	984.37	95.11	270	90	3	22	W	4
0291	V	9	1020.27	984.68	95.10	290	110	3	40	N	1
0291	W	10	1020.28	984.72	95.12	332	152	3	62	S	3
0291	E3	29	1020.33	984.02	95.09	10	10	3	20	N	1
0291	X	11	1020.35	984.67	95.10	340	160	3	22	N	1
0291	J	1	1020.35	984.98	95.12	356	176	3	36	S	3
0258	C	2	1020.36	984.19	95.14	22	22	3	10	S	3

Table A-1. Continued.

Sack	Sub Sack	Field Rec	Northing	Easting	Elevation	Strike	Adj Strike	Group Code	Dip	Dir	Dir Code
0291	H2	15	1020.40	984.48	95.08	328	148	3	5	NE	1
0291	R2	21	1020.42	984.40	95.07	264	84	3	10	W	4
0291	I2	16	1020.48	984.60	95.10	40	40	3	60	SW	3
0291	S2	22	1020.49	984.46	95.10	232	52	3	43	NW	4
0291	L	3	1020.50	984.98	95.12	354	174	3	43	S	3
0291	F3	30	1020.53	984.17	95.12	272	92	3	20	N	1
0291	B2	13	1020.55	984.63	95.08	342	162	3	12	S	3
0291	J2	17	1020.56	984.60	95.09	342	162	3	18	SW	3
0291	H3	31	1020.57	984.05	95.12	240	60	3	40	S	3
0291	T2	23	1020.57	984.41	95.11	30	30	3	82	NE	1
0291		25	1020.62	984.43	95.09	24	24	3	36	SW	3
0291	V2	24	1020.63	984.42	95.10	40	40	3	50	SW	3
0291	D2	5	1020.64	984.74	95.11	28	28	3	45	NE	1
0291	O3	34	1020.67	984.73	95.08	20	20	3	30	N	1
0291	L2	18	1020.72	984.49	95.12	16	16	3	24	N	1
0291	Z2	26	1020.77	984.26	95.12	78	78	3	26	N	1
0291	J3	32	1020.78	984.17	95.12	20	20	3	32	W	4
0291	O	4	1020.78	984.96	95.11	16	16	3	38	E	2
0291	K3	33	1020.85	984.02	95.09	20	20	3	32	S	3
0197	T	1	1021.05	983.19	95.28	302	122	4	22	W	4
0197	P	3	1021.11	983.62	95.26	290	110	4	18	W	4
0197	U	2	1021.15	983.41	95.26	242	62	4	16	W	4
0208	X	3	1021.18	983.20	95.19	323	143	4	29	SW	3
0208	D2	6	1021.22	983.52	95.20	10	10	4	30	E	2
0184	A	1	1021.28	983.49	95.27	320	140	4	22	N	1
0208	E2	7	1021.28	983.68	95.20	35	35	4	15	SW	3
0208	U	5	1021.29	983.04	95.19	90	90	4	4	E	2
0197	L	4	1021.30	983.89	95.26	274	94	4	36	N	1
0208	T	4	1021.32	983.04	95.18	18	18	4	9	E	2
0184	B	2	1021.38	983.51	95.29	350	170	4	46	N	1
0208	K2	8	1021.38	983.80	95.18	52	52	4	29	NW	4
0208	R	2	1021.45	983.18	95.21	40	40	4	15	NW	4
0208	P	9	1021.46	983.58	95.22	62	62	4	17	SE	2
0208		10	1021.52	983.95	95.21	310	130	4	30	E	2
0208	O	11	1021.58	983.52	95.22	62	62	4	52	S	3
0184	C	3	1021.58	983.67	95.28	342	162	4	80	E	2
0208		13	1021.59	983.23	95.17	76	76	4	31	N	1
0208	L	12	1021.70	983.58	95.19	336	156	4	6	E	2
0208	F	1	1021.72	983.33	95.18	326	146	4	18	NW	4
0208	H	15	1021.73	983.19	95.17	80	80	4	17	N	1
0184	D	4	1021.77	983.28	95.27	290	110	4	22	E	2
0208	D	14	1021.85	983.55	95.22	2	2	4	40	N	1
0197	G	7	1021.86	983.68	95.22	266	86	4	4	W	4
0197	C	5	1021.92	983.52	95.23	20	20	4	44	E	2
0197	E	6	1021.92	983.64	95.25	280	100	4	36	W	4
0197	A	1	1021.96	983.45	95.22	290	110	4	18	E	2
0197			1021.98	983.78	0.00	290	110	4	32	W	4
0213		2	1021.05	984.23	95.33	284	104	4	10	N	1
0229	C	1	1021.07	984.16	95.22	322	142	4	34	NE	1
0221		12	1021.08	984.78	95.26	20	20	4	50	S	3

Table A-1. Continued.

Sack	Sub Sack	Field Rec	Northing	Easting	Elevation	Strike	Adj Strike	Group Code	Dip	Dir	Dir Code
0221		1	1021.12	984.08	95.22	344	164	4	28	S	3
0221		11	1021.17	984.72	95.28	298	118	4	56	W	4
0229	D	2	1021.18	984.40	95.22	294	114	4	12	SE	2
0255	F	5	1021.26	984.53	95.12	30	30	4	8	SW	3
0240		3	1021.30	984.60	95.14	54	54	4	34	W	4
0255	U	6	1021.32	984.81	95.10	330	150	4	48	SE	2
0255	T	10	1021.34	984.51	95.11	94	94	4	58	W	4
0221	A	5	1021.35	984.15	95.24	70	70	4	24	E	2
0229	I	4	1021.38	984.70	95.21	40	40	4	14	SW	3
0229		3	1021.41	984.97	95.18	32	32	4	46	N	1
0221	B	4	1021.42	984.21	95.25	44	44	4	18	SW	3
0255	H2	11	1021.46	984.17	95.09	350	170	4	14	N	1
0229		5	1021.47	984.40	95.22	300	120	4	34	W	4
0240	J	4	1021.48	984.02	95.18	300	120	4	36	S	3
0255	M	12	1021.49	984.34	95.11	28	28	4	18	N	1
0221	C	3	1021.49	984.41	95.26	40	40	4	52	SE	2
0255	S	2	1021.49	984.53	95.10	18	18	4	8	S	3
0255	Z	8	1021.49	984.96	95.12	310	130	4	30	SW	3
0221		6	1021.52	984.64	95.22	334	154	4	28	S	3
0240	H	2	1021.60	984.54	95.18	342	162	4	54	E	2
0229	H	7	1021.60	984.96	95.21	0	0	4	20	N	1
0229		8	1021.61	984.35	95.19	254	74	4	30	S	3
0229		6	1021.67	984.28	95.22	276	96	4	42	S	3
0221	F	2	1021.72	984.15	95.23	32	32	4	38	S	3
0213		1	1021.72	984.18	95.33	342	162	4	18	N	1
0221	H	8	1021.73	984.60	95.26	26	26	4	32	NE	1
0255	A2	7	1021.73	984.91	95.11	326	146	4	16	SW	3
0255	D2	4	1021.74	984.46	95.11	44	44	4	58	NE	1
0255	O	14	1021.74	984.81	95.09	12	12	4	50	W	4
0240	G	1	1021.76	984.52	95.17	22	22	4	64	E	2
0221	G	7	1021.78	984.52	95.23	70	70	4	42	S	3
0255	N	13	1021.79	984.90	95.10	42	42	4	30	SW	3
0255	P	15	1021.82	984.67	95.11	40	40	4	12	SE	2
0221		9	1021.82	984.82	25.27	36	36	4	50	S	3
0255	L	1	1021.85	984.46	95.11	80	80	4	42	N	1
0221	I	10	1021.87	984.50	95.28	62	62	4	24	S	3
0255	V	9	1021.38	984.80	95.12	140	140	4	84	W	4

xx = no value recorded
Individual excavation groups coded into groups 1 through 5 to combine contiguous units and achieve sufficient number of observations.
Strike value adjusted to create unidirectional rose diagrams (between 0 and 180 degrees).
Direction codes used to create scatterplots: 1 = N, NE; 2 = E, SE, 3 = S, SW, 4 = N, NW

Table A-2. Artifact Orientation Data Unit 3b

Sack	Sub Sack	Field Rec	Northing	Easting	Elevation	Strike	Adj Strike	Group Code	Dip	Dir	Dir Code
0248	D	3	1015.66	982.56	95.15	134	134	1	19	NE	1
0248	F	4	1015.88	982.63	95.15	2	2	1	20	N	1
0269	E	4	1016.51	982.80	95.13	330	150	1	3	N	1
0269	D	3	1016.75	982.70	95.14	8	8	1	20	N	1
0269	C	2	1016.81	982.35	95.13	0	0	1	17	N	1
0277	B	2	1016.16	982.29	95.12	267	87	1	32	N	1
0277	G	4	1016.22	982.19	95.11	284	104	1	17	N	1
0277	W	11	1016.57	982.04	95.09	248	68	1	40	N	1
0277	B2	14	1016.72	982.04	95.09	22	22	1	55	NE	1
0277	P2	20	1016.76	982.56	95.10	24	24	1	34	NE	1
0277	X2	23	1016.98	982.78	95.13	125	125	1	25	NE	1
0293	X	10	1016.37	982.67	95.05	310	130	1	4	NE	1
0293	J	3	1016.52	982.37	95.05	340	160	1	59	N	1
0293	N	5	1016.57	982.21	95.03	208	28	1	60	NE	1
0293	M	4	1016.58	982.22	95.04	212	32	1	74	NE	1
0293	W	9	1016.90	982.81	95.04	312	132	1	36	N	1
0277	A	1	1016.12	982.44	95.12	344	164	1	36	E	2
0277	L	5	1016.24	982.05	95.11	252	72	1	35	SE	2
0277	O	8	1016.35	982.13	95.11	32	32	1	25	SE	2
0277	Z	13	1016.67	982.12	95.06	342	162	1	16	SE	2
0277	G2	17	1016.95	982.31	95.11	28	28	1	18	SE	2
0277	K2	18	1016.74	982.22	95.10	276	96	1	19	SE	2
0277	M2	19	1016.85	982.41	95.07	344	164	1	20	E	2
0277	Y2	24	1017.00	982.68	95.12	300	120	1	42	SE	2
0293	Q	7	1016.61	982.16	95.02	278	98	1	33	E	2
0270	A	1	1016.96	983.93	95.11	90	90	1	8	E	2
0248	B	2	1015.95	982.90	95.16	90	90	1	74	S	3
0269	M	6	1016.17	982.06	95.13	60	60	1	18	S	3
0269	K	5	1016.41	982.61	95.13	336	156	1	10	SSW	3
0269	N	7	1016.50	982.10	95.12	340	160	1	20	S	3
0277	N	7	1016.34	982.15	95.12	280	100	1	38	S	3
0277	T	9	1016.47	982.11	95.10	26	26	1	14	S	3
0277	E2	16	1016.91	982.01	95.10	34	34	1	4	S	3
0277	Q2	21	1016.95	982.56	95.08	318	138	1	3	SW	3
0277	W2	22	1016.65	982.65	95.14	32	32	1	42	SW	3
0293	S	8	1016.59	982.16	95.02	260	80	1	68	S	3
0293	I	2	1016.76	982.31	95.04	320	140	1	64	SW	3
0248	A	1	1015.72	982.77	95.14	124	124	1	48	NW	4
0269	B	1	1016.61	982.60	95.16	57	57	1	29	NW	4
0277	F	3	1016.22	982.21	95.12	261	81	1	29	W	4
0277	V	10	1016.61	982.12	95.08	240	60	1	25	NW	4
0277	Y	12	1016.70	982.25	95.08	272	92	1	3	W	4
0293	O	6	1016.65	982.17	95.03	130	130	1	84	NW	4
0293	E	1	1016.98	982.22	95.06	12	12	1	88	W	4
0270	B	2	1016.75	983.65	95.14	32	32	1	44	W	4
0270	E	4	1016.04	983.92	95.11	318	138	1	0	horiz	5
0270	C	3	1016.46	983.79	95.12	18	18	1	0	horiz	5
0277	C2	15	1016.74	982.12	95.09	340	160	1	20	SW	3
0319	F	5	1017.79	983.59	95.06	342	162	2	20	N	1

Table A-2. Continued.

Sack	Sub Sack	Field Rec	Northing	Easting	Elevation	Strike	Adj Strike	Group Code	Dip	Dir	Dir Code
0319	H	6	1017.82	983.64	95.08	284	104	2	30	NE	1
0319	K	8	1017.83	983.71	95.07	30	30	2	12	NE	1
0319	P	9	1017.87	983.97	95.02	30	30	2	9	N	1
0319	W2	17	1017.69	983.78	95.03	298	118	2	6	NE	1
0319	J3	19	1017.55	983.30	95.08	64	64	2	52	NE	1
0319	M3	20	1017.50	983.74	95.02	2	2	2	13	N	1
0319	L6	27	1017.59	983.13	95.07	12	12	2	20	N	1
0292	I	7	1017.82	983.69	94.94	120	120	2	10	NE	1
0292	J	8	1017.99	983.90	94.97	146	146	2	20	NE	1
0364	Q3	23	1017.26	983.13	95.00	138	138	2	17	NE	1
0364	F3	22	1017.29	983.34	95.01	324	144	2	4	N	1
0364	B3	20	1017.35	983.24	95.00	208	28	2	37	N	1
0364	C4	25	1017.40	983.63	95.02	119	119	2	36	NE	1
0364	N2	16	1017.54	983.74	95.01	46	46	2	35	N	1
0364	K1	11	1017.63	983.40	95.02	100	100	2	40	N	1
0364	H1	10	1017.75	983.37	95.00	152	152	2	15	NE	1
0364	I	2	1017.90	983.70	95.00	120	120	2	10	NE	1
0364	M	4	1017.94	983.00	94.99	126	126	2	42	NE	1
0305	T2	4	1017.75	984.23	94.98	350	170	2	25	N	1
0322	B2	6	1017.33	984.34	94.94	330	150	2	10	N	1
0322	R	2	1017.79	984.55	94.90	310	130	2	10	N	1
0328	B2	4	1017.75	984.68	94.90	320	140	2	10	NE	1
0347	H	1	1017.74	984.33	94.84	320	140	2	25	N	1
0230	C	1	1017.07	985.76	95.05	282	102	2	44	N	1
0230	D	2	1017.08	985.84	95.05	310	130	2	32	N	1
0314	L3	43	1018.06	982.49	95.11	350	170	2	24	N	1
0314	H3	39	1018.09	982.43	95.09	356	176	2	12	N	1
0314	S2	29	1018.10	982.95	95.11	286	106	2	44	N	1
0314	N3	44	1018.13	982.34	95.08	36	36	2	67	NE	1
0314	E3	37	1018.17	982.51	95.09	314	134	2	25	NE	1
0314	O2	26	1018.18	982.89	95.11	100	100	2	14	N	1
0314	H2	21	1018.33	982.76	95.10	289	109	2	69	N	1
0314	G2	20	1018.35	982.84	95.08	252	72	2	31	N	1
0314	R	12	1018.65	982.79	95.09	50	50	2	43	N	1
0314	Q	11	1018.66	982.82	95.10	352	172	2	35	N	1
0314	O	10	1018.68	982.77	95.11	304	124	2	20	NE	1
0314	Y	16	1018.75	982.53	95.10	65	65	2	11	N	1
0314	K	6	1018.76	982.76	95.10	30	30	2	23	N	1
0314	C	2	1018.87	982.80	95.10	28	28	2	87	NE	1
0422	L2	22	1018.26	983.53	95.12	242	62	2	60	N	1
0422	K2	21	1018.28	983.48	95.08	280	100	2	30	N	1
0422	D2	18	1018.37	983.62	95.12	268	88	2	36	N	1
0422	I2	20	1018.38	983.41	95.09	324	144	2	40	N	1
0422	R	11	1018.66	983.88	95.11	344	164	2	36	N	1
0422	P	10	1018.76	983.59	95.09	230	50	2	2	N	1
0422	K	6	1018.82	983.85	95.08	246	66	2	28	N	1
0422	J	5	1018.84	983.59	95.11	24	24	2	22	N	1
0422	H	3	1018.88	983.52	95.11	350	170	2	4	N	1
0422	F	2	1018.94	983.55	95.10	318	138	2	38	N	1

Table A-2. Continued.

Sack	Sub Sack	Field Rec	Northing	Easting	Elevation	Strike	Adj Strike	Group Code	Dip	Dir	Dir Code
0422	B	1	1018.94	983.72	95.12	270	90	2	12	N	1
0423	R2	33	1018.08	983.22	95.04	0	0	2	2	N	1
0423	K2	29	1018.10	983.15	95.03	2	2	2	14	N	1
0423	J2	28	1018.13	983.18	95.06	80	80	2	18	N	1
0423	Q2	32	1018.16	983.48	95.04	320	140	2	16	N	1
0423	A2	21	1018.38	983.41	95.04	284	104	2	30	N	1
0423	U	17	1018.50	983.74	95.04	314	134	2	50	N	1
0423	S	15	1018.56	983.53	95.06	40	40	2	22	N	1
0423	Q	13	1018.62	983.96	95.07	240	60	2	48	N	1
0423	P	12	1018.63	983.95	95.07	34	34	2	60	N	1
0423	J	9	1018.65	983.55	95.04	48	48	2	14	N	1
0424	H2	20	1018.04	983.75	95.02	270	90	2	18	N	1
0424	G2	19	1018.13	983.71	95.02	144	144	2	38	NE	1
0424	L2	23	1018.25	983.78	95.02	230	50	2	54	N	1
0424	A	1	1018.54	983.92	95.02	240	60	2	40	N	1
0423	T	16	1018.59	983.50	95.06	210	30	2	64	N	1
0320	K	8	1018.39	984.07	95.09	62	62	2	18	N	1
0320	K2	28	1018.48	984.09	95.07	6	6	2	30	N	1
0320	N	11	1018.63	984.06	95.13	130	130	2	40	N	1
0320	R	13	1018.93	984.17	95.08	6	6	2	14	N	1
0320	U	16	1018.97	984.22	95.09	358	178	2	36	N	1
0320	T	15	1018.99	984.18	95.08	350	170	2	28	N	1
0332	Y	18	1018.35	984.41	95.03	44	44	2	10	N	1
0332	N3	47	1018.73	984.82	95.04	47	47	2	39	N	1
0332	M3	46	1018.77	984.77	95.05	316	136	2	56	N	1
0332	H3	42	1018.78	984.58	95.05	344	164	2	27	NE	1
0332	I3	43	1018.82	984.56	95.03	330	150	2	18	N	1
0332	O3	48	1018.98	984.86	95.05	320	140	2	64	NE	1
0332	C3	37	1018.99	984.33	95.07	340	160	2	42	N	1
0353	H3	43	1018.00	984.28	95.01	130	130	2	42	N	1
0353	Y2	34	1018.08	984.65	95.00	90	90	2	26	NE	1
0353	P2	29	1018.24	984.90	95.04	90	90	2	68	N	1
0353	L2	26	1018.27	984.59	95.03	70	70	2	70	N	1
0353	K2	25	1018.37	984.41	94.99	24	24	2	24	N	1
0353	V	15	1018.62	984.80	95.03	0	0	2	32	N	1
0353	F	4	1018.85	984.29	95.03	182	2	2	34	N	1
0353	G	5	1018.85	984.42	95.04	210	30	2	38	N	1
0353	I	6	1018.98	984.55	95.01	190	10	2	32	N	1
0383	A2	16	1018.03	984.60	94.98	242	62	2	44	N	1
0383	W	13	1018.11	984.63	95.00	82	82	2	48	N	1
0383	V	12	1018.15	984.61	94.96	86	86	2	52	NE	1
0397	U	6	1018.05	984.75	94.89	78	78	2	16	N	1
0319	G	1	1017.95	983.60	95.09	10	10	2	38	E	2
0319	E3	18	1017.59	983.15	95.07	66	66	2	8	SE	2
0319	Y5	25	1017.75	983.42	95.02	236	56	2	16	E	2
0319	E6	26	1017.71	983.62	95.02	278	98	2	26	E	2
0319	P6	28	1017.56	983.15	95.04	296	116	2	28	E	2
0319	Q6	29	1017.58	983.32	95.02	330	150	2	22	E	2
0319	T6	31	1017.65	983.38	95.02	270	90	2	16	E	2

Table A-2. Continued.

Sack	Sub Sack	Field Rec	Northing	Easting	Elevation	Strike	Adj Strike	Group Code	Dip	Dir	Dir Code
0364	R2	17	1017.44	983.08	95.01	340	160	2	34	E	2
0364	I2	15	1017.44	983.46	95.00	32	32	2	40	SE	2
0364	N	12	1017.58	983.47	95.01	40	40	2	48	E	2
0364	Q	5	1017.69	983.36	95.03	42	42	2	22	SE	2
0364	S	6	1017.76	983.34	95.02	58	58	2	14	SE	2
0364	B1	8	1017.79	983.83	95.01	298	118	2	8	E	2
0364	C	9	1017.87	983.96	95.00	82	82	2	5	E	2
0364	K	3	1017.96	983.92	94.99	110	110	2	30	E	2
0305	M	1	1017.90	984.17	94.98	10	10	2	25	E	2
0305	N	2	1017.94	984.06	94.99	280	100	2	25	E	2
0322	V	4	1017.64	984.27	94.95	270	90	2	10	E	2
0328	O	3	1017.69	984.15	94.92	270	90	2	20	E	2
0328	J	1	1017.70	984.05	94.92	330	150	2	20	E	2
0328	K	2	1017.75	984.06	94.91	360	180	2	10	E	2
0328	G2	5	1017.98	984.42	94.93	250	70	2	10	E	2
0242	C	1	1017.20	985.85	95.01	45	45	2	45	E	2
0261	U	4	1018.02	982.79	95.18	284	104	2	17	E	2
0261	W	5	1018.07	982.84	95.16	29	29	2	31	SE	2
0261	Q	2	1018.12	982.62	95.15	58	58	2	9	SE	2
0314	Q2	27	1018.08	982.92	95.09	102	102	2	39	E	2
0314	R2	28	1018.11	982.85	95.10	30	30	2	85	E	2
0314	K3	42	1018.14	982.40	95.11	30	30	2	15	SE	2
0314	M2	24	1018.18	982.84	95.08	354	174	2	32	E	2
0314	N2	25	1018.18	982.87	95.09	92	92	2	33	E	2
0314	R3	46	1018.25	982.23	95.07	96	96	2	29	E	2
0314	B2	18	1018.42	982.62	95.09	60	60	2	24	SE	2
0314	T	13	1018.53	982.90	95.10	359	179	2	37	E	2
0314	X	15	1018.77	982.63	95.09	77	77	2	20	E	2
0314	E	3	1018.78	982.88	95.11	244	64	2	40	E	2
0422	Z	15	1018.54	983.85	95.12	270	90	2	52	SE	2
0422	Y	14	1018.65	983.54	95.12	270	90	2	52	E	2
0422	S	12	1018.70	983.60	95.12	208	28	2	80	E	2
0422	N	8	1018.73	983.74	95.09	14	14	2	24	E	2
0423	S2	34	1018.03	983.24	95.03	290	110	2	2	E	2
0423	L2	30	1018.08	983.26	95.07	280	100	2	4	E	2
0423	V2	36	1018.14	983.77	95.05	176	176	2	34	E	2
0423	T2	35	1018.15	983.64	95.04	20	20	2	34	E	2
0423	H2	26	1018.22	983.68	95.05	310	130	2	50	SE	2
0423	C2	23	1018.25	983.30	95.07	300	120	2	22	E	2
0423	F2	24	1018.27	983.60	95.07	10	10	2	48	E	2
0423	W2	37	1018.31	983.77	95.05	24	24	2	44	E	2
0423	B2	22	1018.33	983.64	95.07	314	134	2	30	E	2
0423	W	19	1018.42	983.87	95.06	30	30	2	46	SE	2
0423	K	10	1018.60	983.60	95.03	300	120	2	26	E	2
0423	O	11	1018.64	983.84	95.04	60	60	2	12	E	2
0423	C	3	1018.87	983.78	95.06	350	170	2	12	E	2
0424	Y	16	1018.03	983.33	95.00	174	174	2	20	E	2
0424	Z	17	1018.05	983.30	95.01	238	58	2	26	E	2
0424	I2	21	1018.10	983.83	95.06	330	150	2	32	E	2

Table A-2. Continued.

Sack	Sub Sack	Field Rec	Northing	Easting	Elevation	Strike	Adj Strike	Group Code	Dip	Dir	Dir Code
0424	C2	18	1018.16	983.46	95.00	230	50	2	16	SE	2
0424	O2	25	1018.17	983.87	95.02	218	38	2	34	E	2
0424	J2	22	1018.19	983.78	95.06	260	80	2	38	E	2
0424	M2	24	1018.23	983.85	95.03	232	52	2	38	SE	2
0424	R	10	1018.32	983.51	95.01	222	42	2	46	E	2
0424	L	5	1018.33	983.36	95.02	250	70	2	22	E	2
0424	S	11	1018.33	983.49	95.02	340	160	2	34	SE	2
0424	N	7	1018.37	983.39	95.02	230	50	2	44	SE	2
0320	M	10	1018.53	984.12	95.08	52	52	2	44	E	2
0320	O	12	1018.61	984.07	95.07	2	2	2	40	E	2
0320	L2	29	1018.71	984.02	95.07	30	30	2	6	E	2
0332	L	8	1018.05	984.49	95.06	34	34	2	48	E	2
0332	F	3	1018.07	984.18	95.03	132	132	2	22	NE	2
0332	J	6	1018.13	984.39	95.05	134	134	2	38	E	2
0332	K	7	1018.16	984.36	95.06	134	134	2	28	E	2
0332	O	10	1018.21	984.60	95.06	70	70	2	38	E	2
0332	R	13	1018.30	984.06	95.08	110	110	2	8	E	2
0332	C2	20	1018.50	984.09	95.07	12	12	2	60	E	2
0332	K2	25	1018.50	984.63	95.05	0	0	2	16	E	2
0332	H2	23	1018.54	984.45	95.06	328	148	2	26	E	2
0332	P2	29	1018.55	984.29	95.06	132	132	2	24	SE	2
0332	W2	35	1018.61	984.14	95.04	104	104	2	12	E	2
0332	S3	51	1018.65	984.40	95.06	70	70	2	4	E	2
0332	R2	31	1018.74	984.25	95.06	70	70	2	20	E	2
0332	L3	45	1018.94	984.70	95.02	54	54	2	8	E	2
0353	B3	37	1018.00	984.54	94.99	140	140	2	46	SE	2
0353	C3	38	1018.01	984.43	94.98	140	140	2	28	SE	2
0353	G3	42	1018.02	984.38	94.97	128	128	2	30	E	2
0353	F3	41	1018.02	984.42	94.99	216	36	2	60	SE	2
0353	D3	39	1018.04	984.45	94.99	60	60	2	58	SE	2
0353	E3	40	1018.04	984.45	94.99	120	120	2	50	SE	2
0353	J3	44	1018.06	984.21	95.00	130	130	2	40	E	2
0353	W2	33	1018.12	984.57	95.00	44	44	2	38	E	2
0353	Y	18	1018.40	984.87	95.02	110	110	2	66	SE	2
0353	Q	12	1018.47	984.51	95.00	150	150	2	50	SE	2
0353	L	9	1018.54	984.14	94.99	50	50	2	22	E	2
0353	S	13	1018.54	984.66	95.01	354	174	2	30	E	2
0353	E	3	1018.77	984.06	95.02	338	158	2	32	E	2
0383	J	3	1018.03	984.22	94.93	6	6	2	36	E	2
0383	K	4	1018.10	984.24	94.95	320	140	2	46	SE	2
0383	H2	21	1018.13	984.59	94.97	22	22	2	54	E	2
0383	M	6	1018.17	984.19	94.96	44	44	2	36	E	2
0383	H	2	1018.23	984.11	94.97	120	120	2	34	SE	2
0397	A	1	1018.04	984.04	94.91	66	66	2	18	SE	2
0353	J	7	1018.72	984.32	95.02	82	82	2	44	E	2
0319	M	2	1017.93	983.90	95.05	324	144	2	4	S	3
0319	X	3	1017.83	983.27	95.05	246	66	2	20	SW	3
0319	W	10	1017.71	983.39	95.06	278	98	2	30	S	3
0319	H2	12	1017.69	983.09	95.07	320	140	2	15	SW	3

Table A-2. Continued.

Sack	Sub Sack	Field Rec	Northing	Easting	Elevation	Strike	Adj Strike	Group Code	Dip	Dir	Dir Code
0319	J2	14	1017.63	983.10	95.07	16	16	2	21	S	3
0319	T2	16	1017.61	983.98	95.08	370	190	2	19	SW	3
0319	Z3	21	1017.29	983.03	95.03	318	138	2	22	SW	3
0319	L4	23	1017.26	983.23	95.05	32	32	2	25	S	3
0319	O5	24	1017.83	983.27	95.04	272	92	2	20	S	3
0319	R6	30	1017.58	983.34	95.02	254	74	2	10	S	3
0292	G	6	1017.83	983.55	94.95	64	64	2	32	S	3
0364	T3	24	1017.21	983.17	94.99	349	169	2	8	S	3
0364	C3	21	1017.33	983.28	94.99	308	128	2	3	SW	3
0364	S2	18	1017.37	983.20	95.02	271	91	2	21	S	3
0364	K2	14	1017.55	983.55	95.00	316	136	2	15	SW	3
0364	S1	13	1017.65	983.63	95.00	30	30	2	15	S	3
0364	G	1	1017.97	983.74	95.02	120	120	2	36	S	3
0322	N	5	1017.87	984.55	94.97	250	70	2	75	S	3
0347	B	2	1017.86	984.58	94.89	200	20	2	30	S	3
0347	A	3	1017.87	984.53	94.89	230	50	2	30	S	3
0261	P	1	1018.17	982.57	95.16	20	20	2	11	S	3
0261	R	3	1018.23	982.61	95.15	310	130	2	17	SW	3
0261	Q2	7	1018.89	982.18	95.15	344	164	2	23	S	3
0261	I2	8	1018.94	982.69	95.12	322	142	2	4	S	3
0314	T2	30	1018.07	982.83	95.10	358	178	2	9	S	3
0314	V3	47	1018.08	982.18	95.08	309	129	2	62	S	3
0314	Z2	34	1018.13	982.70	95.10	318	138	2	28	S	3
0314	W2	33	1018.14	982.82	95.10	50	50	2	50	S	3
0314	X3	48	1018.19	982.13	95.10	23	23	2	58	S	3
0314	O3	45	1018.20	982.34	95.09	318	138	2	12	SW	3
0314	J3	41	1018.22	982.41	95.10	324	144	2	18	S	3
0314	I3	40	1018.26	982.41	95.10	299	119	2	10	SW	3
0314	G3	38	1018.31	982.53	95.11	318	138	2	255	SW	3
0314	M	8	1018.72	982.80	95.09	358	178	2	19	S	3
0314	H	4	1018.80	982.90	95.11	176	176	2	54	S	3
0314	U2	31	1018.95	982.82	95.10	80	80	2	45	SW	3
0335	E	2	1018.76	982.76	95.07	128	128	2	24	S	3
0314	F2	19	1018.35	982.78	95.10	296	116	2	12	SW	3
0422	V	13	1018.56	983.91	95.13	22	22	2	12	S	3
0422	M	7	1018.74	983.78	95.09	350	170	2	20	S	3
0422	I	4	1018.88	983.51	95.11	198	18	2	18	S	3
0423	R	14	1018.52	983.55	95.06	222	42	2	4	S	3
0423	E	5	1018.90	983.58	95.07	274	94	2	50	S	3
0424	X	15	1018.04	983.23	95.03	312	132	2	28	S	3
0424	Q2	26	1018.18	983.61	94.99	182	2	2	36	S	3
0424	V	13	1018.32	983.80	95.02	290	110	2	42	S	3
0424	W	14	1018.35	983.87	95.02	190	10	2	22	S	3
0424	U	12	1018.36	983.78	95.05	290	110	2	50	S	3
0424	I	2	1018.37	983.42	95.03	350	170	2	20	S	3
0320	C	1	1018.06	984.03	95.12	50	50	2	34	S	3
0320	H	6	1018.11	984.53	95.07	110	110	2	8	S	3
0320	I	7	1018.13	984.79	95.11	114	114	2	52	S	3
0320	D	2	1018.15	984.28	95.08	22	22	2	30	S	3

Table A-2. Continued.

Sack	Sub Sack	Field Rec	Northing	Easting	Elevation	Strike	Adj Strike	Group Code	Dip	Dir	Dir Code
0320	E	3	1018.30	984.06	95.09	80	80	2	14	E	3
0320	J2	27	1018.31	984.08	95.09	84	84	2	70	S	3
0320	A2	20	1018.48	984.48	95.07	84	84	2	24	S	3
0320	X	17	1018.64	984.45	95.11	6	6	2	28	S	3
0320	F2	24	1018.81	984.61	95.07	16	16	2	18	S	3
0320	G2	25	1018.82	984.58	95.08	124	124	2	8	S	3
0320	I2	26	1018.97	984.79	95.08	0	0	2	8	S	3
0332	H	5	1018.08	984.23	95.06	342	162	2	32	S	3
0332	G	4	1018.09	984.26	95.03	132	132	2	24	S	3
0332	M	9	1018.11	984.48	95.06	120	120	2	24	S	3
0332	V	17	1018.34	984.28	95.05	150	150	2	16	SW	3
0332	Q2	30	1018.42	984.03	95.06	110	110	2	28	S	3
0332	E2	21	1018.44	984.38	95.04	20	20	2	40	S	3
0332	F2	22	1018.45	984.46	95.03	90	90	2	32	S	3
0332	I2	24	1018.55	984.53	95.05	90	90	2	8	E	3
0332	Y2	36	1018.77	984.36	95.06	336	156	2	16	S	3
0332	V2	34	1018.79	984.25	95.06	128	128	2	16	SW	3
0332	K3	44	1018.80	984.66	95.02	18	18	2	31	S	3
0332	R3	50	1018.82	984.85	95.05	300	120	2	34	S	3
0332	U2	33	1018.83	984.21	95.05	344	164	2	22	S	3
0332	E3	39	1018.95	984.42	95.07	306	126	2	25	SW	3
0353	C	1	1018.01	984.05	95.02	50	50	2	40	S	3
0353	A3	36	1018.05	984.65	95.01	160	160	2	2	S	3
0353	F2	22	1018.23	984.10	95.01	74	74	2	10	S	3
0353	J2	24	1018.30	984.38	95.00	54	54	2	32	S	3
0353	X	17	1018.42	984.85	95.02	14	14	2	24	S	3
0353	N	11	1018.54	984.24	95.02	146	146	2	66	SW	3
0353	M	10	1018.54	984.24	95.01	60	60	2	36	S	3
0383	R	10	1018.04	984.33	94.96	266	86	2	22	S	3
0383	O	8	1018.06	984.28	94.97	240	60	2	28	SW	3
0383	B2	17	1018.07	984.55	94.98	122	122	2	18	SW	3
0383	L	5	1018.13	984.27	94.95	352	172	2	60	S	3
0383	D2	18	1018.15	984.71	94.98	22	22	2	26	SW	3
0383	G2	20	1018.37	984.24	94.92	54	54	2	28	S	3
0397	X	8	1018.07	984.95	94.88	8	8	2	8	S	3
0397	R	5	1018.15	984.74	94.92	76	76	2	48	S	3
0397	O	4	1018.26	984.64	94.92	66	66	2	24	S	3
0408	E	2	1018.03	984.58	94.86	350	170	2	16	S	3
0408	A	1	1018.21	984.63	94.89	64	64	2	6	S	3
0319	Z	4	1017.84	983.50	95.06	306	126	2	20	W	4
0319	J	7	1017.83	983.67	95.06	36	36	2	3	NW	4
0319	E2	11	1017.77	983.98	95.05	130	130	2	33	NW	4
0319	I2	13	1017.64	983.06	95.08	344	164	2	17	W	4
0319	R2	15	1017.63	983.36	95.08	274	94	2	21	W	4
0319	E4	22	1017.38	983.28	95.04	352	172	2	68	W	4
0364	U2	19	1017.42	983.50	95.00	208	28	2	33	NW	4
0364	A1	7	1017.85	983.83	95.00	76	76	2	23	W	4
0305	G2	3	1017.47	984.56	94.98	270	90	2	5	W	4
0322	A2	3	1017.62	984.56	94.95	270	90	2	10	W	4

Table A-2. Continued.

Sack	Sub Sack	Field Rec	Northing	Easting	Elevation	Strike	Adj Strike	Group Code	Dip	Dir	Dir Code
0322	I	1	1017.97	984.34	94.96	250	70	2	10	W	4
0314	B3	35	1018.04	982.77	95.09	266	86	2	8	W	4
0314	V2	32	1018.09	982.79	95.10	260	80	2	22	W	4
0314	D3	36	1018.12	982.51	95.10	280	100	2	4	W	4
0314	L2	23	1018.23	982.86	95.09	38	38	2	26	NW	4
0314	K2	22	1018.26	982.85	95.08	26	26	2	42	W	4
0314	V	14	1018.57	982.81	95.10	80	80	2	3	W	4
0314	Z	17	1018.71	982.51	95.09	49	49	2	1	NW	4
0314	N	9	1018.71	982.78	95.08	28	28	2	12	W	4
0314	L	7	1018.73	982.77	95.10	6	6	2	40	NW	4
0314	J	5	1018.83	982.91	95.09	260	80	2	24	W	4
0314	B	1	1018.84	982.75	95.10	328	148	2	24	NW	4
0335	B	3	1018.26	982.98	95.05	180	180	2	18	W	4
0335	F	1	1018.88	982.98	95.08	218	38	2	44	NW	4
0422	M2	23	1018.28	983.56	95.12	320	140	2	14	NW	4
0422	C2	17	1018.47	983.90	95.13	300	120	2	56	NW	4
0422	F2	19	1018.54	983.48	95.12	250	70	2	44	W	4
0422	A2	16	1018.54	983.79	95.09	284	104	2	12	NW	4
0422	O	9	1018.71	983.63	95.09	172	172	2	26	W	4
0423	N2	31	1018.17	983.36	95.04	280	100	2	20	W	4
0423	G2	25	1018.22	983.65	95.06	310	130	2	12	NW	4
0423	I2	27	1018.26	983.67	95.06	218	38	2	16	NW	4
0423	X2	38	1018.28	983.90	95.05	50	50	2	70	NW	4
0423	V	18	1018.49	983.75	95.06	180	180	2	40	W	4
0423	H	8	1018.63	983.56	95.07	170	170	2	16	W	4
0423	G	7	1018.82	983.49	95.07	184	4	2	24	W	4
0423	B	2	1018.90	983.90	95.04	270	90	2	4	W	4
0423	D	4	1018.92	983.78	95.06	8	8	2	32	W	4
0423	F	6	1018.94	983.58	95.05	36	36	2	26	W	4
0424	R2	27	1018.27	983.82	95.02	274	94	2	46	W	4
0424	P	9	1018.33	983.45	95.01	294	114	2	26	W	4
0424	O	8	1018.39	983.44	95.02	280	100	2	32	W	4
0424	J	3	1018.44	983.43	95.01	350	170	2	20	W	4
0424	K	4	1018.53	983.63	95.02	296	116	2	4	W	4
0320	F	4	1018.19	984.24	95.09	30	30	2	24	W	4
0320	Z	19	1018.39	984.51	95.09	310	130	2	12	NW	4
0320	G	5	1018.40	984.25	95.08	2	2	2	24	W	4
0320	Y	18	1018.44	984.48	95.09	100	100	2	24	W	4
0320	C2	21	1018.57	984.61	95.08	60	60	2	36	NW	4
0320	E2	23	1018.76	984.61	95.07	80	80	2	8	NW	4
0320	M2	30	1018.92	984.56	95.08	320	140	2	18	W	4
0320	S	14	1018.94	984.15	95.08	42	42	2	30	NW	4
0332	U	16	1018.00	984.18	95.03	58	58	2	20	W	4
0332	E	2	1018.11	984.09	95.05	14	13	2	12	W	4
0332	S	14	1018.31	984.06	95.06	84	84	2	2	W	4
0332	M2	26	1018.59	984.71	95.03	104	104	2	4	NW	4
0332	N2	27	1018.59	984.83	95.03	140	140	2	30	NW	4
0332	Q3	49	1018.75	984.89	95.05	264	84	2	26	W	4
0332	G3	41	1018.91	984.46	95.06	310	130	2	36	NW	4

Table A-2. Continued.

Sack	Sub Sack	Field Rec	Northing	Easting	Elevation	Strike	Adj Strike	Group Code	Dip	Dir	Dir Code
0332	D3	38	1018.99	984.39	95.06	46	46	2	12	NW	4
0353	D	2	1018.03	984.09	95.04	164	164	2	20	W	4
0353	U2	31	1018.05	984.57	95.03	90	90	2	24	W	4
0353	Q2	30	1018.22	984.90	95.05	50	50	2	52	NW	4
0353	W	16	1018.43	984.81	95.02	84	84	2	2	W	4
0353	K3	45	1018.54	984.14	94.98	42	42	2	42	W	4
0353	K	8	1018.58	984.18	95.01	38	38	2	52	W	4
0383	E2	19	1018.13	984.74	95.00	254	74	2	28	W	4
0383	S	11	1018.18	984.42	94.96	228	48	2	12	NW	4
0383	N	7	1018.19	984.20	94.95	306	126	2	12	W	4
0383	A	1	1018.31	984.27	94.96	42	42	2	38	W	4
0397	G	2	1018.00	984.33	94.89	90	90	2	8	W	4
0397	V	7	1018.07	984.75	94.88	96	96	2	2	W	4
0397	K	3	1018.13	984.31	94.91	320	140	2	40	NW	4
0423	Z	20	1018.43	983.53	95.05	280	100	2	0	horiz	5
0424	M	6	1018.39	983.37	95.00	308	128	2	0	horiz	5
0332	D	1	1018.06	984.06	95.05	34	34	2	0	horiz	5
0332	Q	12	1018.23	984.10	95.02	62	62	2	0	horiz	5
0244	T3	34	1019.17	982.75	95.14	342	162	3	25	N	1
0244	L2	16	1019.40	982.18	95.13	122	122	3	11	NE	1
0244	K2	15	1019.53	982.20	95.13	202	22	3	42	NE	1
0244	X	8	1019.75	982.35	95.17	65	65	3	19	N	1
0215	Q2	10	1019.69	983.72	95.16	25	25	3	60	NE	1
0215	P2	9	1019.76	983.65	95.15	26	26	3	5	N	1
0215	O2	8	1019.79	983.70	95.16	130	130	3	26	NE	1
0283	B	1	1019.72	983.96	95.07	268	88	3	42	N	1
0288	U2	28	1020.18	982.36	95.17	10	10	3	13	N	1
0288	T2	32	1020.21	982.39	95.13	342	162	3	63	N	1
0288	K	10	1020.41	982.52	95.19	76	76	3	16	N	1
0288	U	16	1020.45	982.55	95.18	299	119	3	36	NE	1
0288	M	12	1020.52	982.60	95.18	212	32	3	46	N	1
0288	Z2	29	1020.64	982.33	95.17	311	131	3	42	NE	1
0300	D	4	1020.48	982.81	95.13	38	38	3	65	NE	1
0252	B	2	1020.05	983.03	95.16	314	134	3	24	NE	1
0252	F3	12	1020.29	983.90	95.15	72	72	3	46	N	1
0279	V	9	1020.18	983.59	95.10	22	22	3	4	N	1
0279	L	7	1020.46	983.75	95.10	224	44	3	18	N	1
0279	J	5	1020.56	983.80	95.12	350	170	3	22	N	1
0304	J	1	1020.10	984.80	95.06	250	70	3	28	N	1
0304	U	6	1020.19	984.40	95.06	22	22	3	8	N	1
0304	Y	4	1020.32	984.63	95.06	250	70	3	82	N	1
0244	Z2	25	1019.05	982.10	95.17	25	25	3	53	E	2
0244	Y2	24	1019.22	982.20	95.14	118	118	3	44	E	2
0244	U2	20	1019.35	982.72	95.13	26	26	3	9	SE	2
0244	O2	18	1019.45	982.40	95.13	158	158	3	29	E	2
0244	T2	19	1019.50	982.70	95.14	106	106	3	14	E	2
0244	A2	10	1019.75	982.55	95.14	83	83	3	35	E	2
0268	R	1	1019.02	982.82	95.12	272	92	3	30	E	2
0268	S	2	1019.04	982.85	95.11	260	80	3	18	E	2

Table A-2. Continued.

Sack	Sub Sack	Field Rec	Northing	Easting	Elevation	Strike	Adj Strike	Group Code	Dip	Dir	Dir Code
0268	D2	4	1019.42	982.61	95.08	18	18	3	44	E	2
0268	X	5	1019.43	982.54	95.11	290	110	3	10	E	2
0268	V	6	1019.50	982.55	95.11	36	36	3	40	SE	2
0244	G2	13	1019.75	982.85	95.17	152	152	3	34	SE	2
0215	W2	16	1019.21	983.25	95.12	46	46	3	7	SE	2
0215	U2	14	1019.35	983.51	95.15	65	65	3	23	SE	2
0215	H2	1	1019.38	983.65	95.17	102	102	3	13	E	2
0215	J 2	3	1019.42	983.85	95.14	64	64	3	23	SE	2
0215	M2	6	1019.50	983.49	95.17	150	150	3	23	E	2
0215	L2	5	1019.69	983.85	95.15	74	74	3	22	E	2
0215	R2	11	1019.72	983.63	95.15	170	170	3	19	E	2
0215	K3	20	1019.75	983.42	95.12	108	108	3	26	E	2
0283	E	4	1019.12	983.63	95.06	186	6	3	26	E	2
0283	D	3	1019.20	983.90	95.06	242	62	3	10	E	2
0288	K2	25	1020.05	982.45	95.14	331	151	3	51	SE	2
0288	O2	26	1020.09	982.37	95.16	34	34	3	61	E	2
0288	A2	20	1020.26	982.87	95.13	318	138	3	29	SE	2
0288	B2	21	1020.27	982.40	95.14	278	98	3	3	E	2
0288	A	1	1020.33	982.95	95.16	306	126	3	52	SE	2
0288	C	3	1020.50	982.90	95.16	54	54	3	16	E	2
0288	F	6	1020.60	982.70	95.15	296	116	3	18	SE	2
0288	S	14	1020.85	982.33	95.18	20	20	3	30	E	2
0288	Z	19	1020.95	982.84	95.14	2	2	3	51	E	2
0300	C	3	1020.47	982.61	95.12	282	102	3	35	E	2
0252	K	8	1020.04	983.32	95.14	80	80	3	30	SE	2
0252	M3	19	1020.05	983.40	95.12	302	122	3	38	SE	2
0252	D	4	1020.06	983.13	95.14	310	130	3	76	SE	2
0252	M	20	1020.10	983.37	95.15	300	120	3	26	E	2
0252	I	33	1020.13	983.29	95.13	128	128	3	14	SE	2
0252	I2	14	1020.13	983.73	95.13	306	126	3	14	E	2
0252	N2	24	1020.45	983.75	95.15	34	34	3	38	E	2
0279	X	10	1020.18	983.27	95.09	100	100	3	26	E	2
0279	G	4	1020.36	983.92	95.11	26	26	3	34	E	2
0304	Z	7	1020.04	984.29	95.06	232	52	3	4	SE	2
0244	M3	31	1019.02	982.50	95.16	290	110	3	39	S	3
0244	V3	35	1019.10	982.81	95.17	330	150	3	1	S	3
0244	D3	27	1019.13	982.34	95.17	72	72	3	28	S	3
0244	V2	21	1019.15	982.09	95.17	328	148	3	24	SW	3
0244	C3	26	1019.17	982.25	95.13	350	170	3	23	S	3
0244	S3	33	1019.22	982.73	95.14	20	20	3	25	S	3
0244	M2	17	1019.35	982.18	95.13	76	76	3	30	S	3
0244	S	4	1019.80	982.02	95.14	28	28	3	11	S	3
0244	H2	14	1019.80	982.90	95.13	199	19	3	40	SW	3
0244	O	1	1019.91	982.16	95.14	52	52	3	32	SW	3
0244	Q	3	1019.99	982.35	95.17	202	22	3	39	SW	3
0268		3	1019.40	982.10	95.11	320	140	3	32	S	3
0215	X2	17	1019.11	983.60	95.13	6	6	3	15	S	3
0215	I2	2	1019.19	983.75	95.14	100	100	3	56	S	3
0215	K2	4	1019.49	983.87	95.14	92	92	3	65	S	3

Table A-2. Continued.

Sack	Sub Sack	Field Rec	Northing	Easting	Elevation	Strike	Adj Strike	Group Code	Dip	Dir	Dir Code
0215	S2	12	1019.60	983.50	95.17	0	0	3	19	S	3
0215	M3	22	1019.65	983.48	95.13	118	118	3	20	SW	3
0215	Y2	18	1019.82	983.03	95.14	62	62	3	28	S	3
0283	C	2	1019.63	983.96	95.07	166	166	3	4	S	3
0423	A	1	1019.03	983.92	95.05	0	0	3	8	S	3
0288	N2	30	1020.03	982.40	95.17	326	146	3	14	SW	3
0288	J2	24	1020.09	982.56	95.16	338	158	3	70	S	3
0288	C2	22	1020.16	982.40	95.15	320	140	3	11	SW	3
0288	V	17	1020.46	982.81	95.14	316	136	3	50	SW	3
0288	E	5	1020.46	982.86	95.18	324	144	3	4	SW	3
0288	H	8	1020.48	982.70	95.15	0	0	3	4	S	3
0288	D	4	1020.55	982.81	95.18	30	30	3	30	S	3
0288	T	15	1020.68	982.28	95.20	122	122	3	50	S	3
0288	N	13	1020.78	982.55	95.20	140	140	3	46	SW	3
0300	B	2	1020.05	982.22	95.12	270	90	3	22	S	3
0300	E	5	1020.06	982.09	95.09	300	120	3	28	S	3
0252	J	7	1020.02	983.26	95.13	84	84	3	48	S	3
0252	E	5	1020.08	983.20	95.16	76	76	3	48	SW	3
0252	G	6	1020.08	983.22	95.14	334	154	3	10	SW	3
0252	C	3	1020.12	983.11	95.15	90	90	3	80	S	3
0252	J2	13	1020.12	983.76	95.14	322	142	3	46	S	3
0252	E2	17	1020.31	983.52	95.14	290	110	3	34	S	3
0252	M2	16	1020.42	983.75	95.15	6	6	3	12	S	3
0252	V2	22	1020.50	983.65	95.15	250	70	3	34	S	3
0279	S	8	1020.08	983.75	95.10	200	20	3	18	S	3
0279	D	2	1020.11	983.98	95.10	358	178	3	8	S	3
0279	E	3	1020.24	983.94	95.10	4	4	3	32	S	3
0316	C	1	1020.63	984.97	94.98	318	138	3	8	S	3
0244	N3	32	1019.02	982.60	95.16	230	50	3	12	NW	4
0244	E3	28	1019.19	982.32	95.13	29	29	3	5	NW	4
0244	X2	23	1019.25	982.09	95.14	352	172	3	43	W	4
0244	F2	12	1019.65	982.85	95.17	204	24	3	8	W	4
0244	U	6	1019.74	982.01	95.15	136	136	3	29	NW	4
0215	T2	13	1019.18	983.62	95.13	284	104	3	26	W	4
0215	V2	15	1019.35	983.47	95.15	80	80	3	3	W	4
0215	N2	7	1019.53	983.80	95.16	96	96	3	34	W	4
0215	L3	21	1019.72	983.43	95.12	42	42	3	15	NW	4
0215	J3	19	1019.88	983.50	95.14	92	92	3	26	W	4
0283	F	5	1019.05	983.76	95.06	270	90	3	50	W	4
0283	I	6	1019.49	983.90	95.06	160	160	3	38	W	4
0288	Q2	27	1020.05	982.28	95.16	336	156	3	82	W	4
0288	D2	23	1020.36	982.28	95.14	332	152	3	24	NW	4
0288	J	9	1020.44	982.55	95.19	20	20	3	16	NW	4
0288	F3	33	1020.50	982.67	95.13	284	104	3	9	W	4
0288	W	18	1020.51	982.73	95.13	278	98	3	8	W	4
0288	G	7	1020.55	982.68	95.16	316	136	3	16	W	4
0300	A	1	1020.07	982.30	95.11	28	28	3	20	W	4
0252	N	18	1020.07	983.41	95.13	90	90	3	8	W	4
0252	R	10	1020.24	983.29	95.14	27	27	3	14	W	4

Table A-2. Continued.

Sack	Sub Sack	Field Rec	Northing	Easting	Elevation	Strike	Adj Strike	Group Code	Dip	Dir	Dir Code
0252	V	21	1020.27	983.45	95.12	310	130	3	14	W	4
0252	W2	23	1020.42	983.58	95.13	16	16	3	30	W	4
0252	D3	15	1020.42	983.89	95.13	310	130	3	10	W	4
0252	T3	35	1020.52	983.04	95.17	122	122	3	46	W	4
0279	C	1	1020.06	983.97	95.10	158	158	3	58	W	4
0279	Z	11	1020.09	983.26	95.10	310	130	3	28	NW	4
0304	K	2	1020.16	984.86	95.04	310	130	3	4	W	4
0304	S	5	1020.20	984.51	95.04	230	50	3	6	NW	4
0244	I3	29	1019.22	982.38	95.17	9	9	3	0	horiz	5
0288	B	2	1020.44	982.94	95.15	74	74	3	0	horiz	5
0252	A	1	1020.11	983.07	95.17	4	4	3	0	horiz	5
0304	N	3	1020.38	984.72	95.03	70	70	3	0	horiz	5
0252	H	34	1020.09	983.28	95.13	158	158	3	2	N	1
0329	A	1	1021.14	984.73	95.08	312	132	4	8	NE	1
0288	G3	31	1021.06	982.36	95.14	300	120	4	38	NW	4
0230	H	6	1017.56	985.00	95.05	334	154	5	8	N	1
0230	G	5	1017.72	985.50	95.06	334	154	5	50	N	1
0242	E	2	1017.45	985.00	95.01	20	20	5	30	N	1
0242	J	5	1017.59	985.34	95.00	140	140	5	30	N	1
0242	V	14	1017.60	985.49	94.99	175	175	5	15	N	1
0242	L	7	1017.67	985.34	95.02	125	125	5	15	N	1
0251	B	1	1017.60	985.87	94.97	180	180	5	36	N	1
0251	N	13	1017.62	985.27	94.97	32	32	5	4	N	1
0251	F	5	1017.67	985.44	94.97	14	14	5	16	N	1
0251	E	4	1017.71	985.49	94.97	320	140	5	18	NE	1
0251	H	7	1017.81	985.46	94.97	338	158	5	52	N	1
0251	J	9	1017.84	985.40	94.96	320	140	5	20	NE	1
0251	F	6	1017.86	985.45	94.97	36	36	5	16	N	1
0263	K	10	1017.82	985.47	94.93	342	162	5	28	N	1
0263	M	12	1017.87	985.49	94.94	30	30	5	24	N	1
0275	D	3	1018.00	985.60	94.85	0	0	5	4	N	1
0287	C	2	1017.74	986.08	94.97	330	150	5	2	NE	1
0292	E	4	1017.85	986.20	94.98	22	22	5	14	N	1
0298	A	1	1017.84	986.42	94.94	64	64	5	22	NE	1
0298	B	2	1017.88	986.96	94.92	324	144	5	38	NE	1
0242	Q	12	1017.64	985.51	95.02	260	80	5	55	E	2
0242	H	4	1017.67	985.24	95.01	50	50	5	25	E	2
0251	O	14	1017.66	985.26	94.96	310	130	5	46	SE	2
0263	F	6	1017.67	985.38	94.90	70	70	5	18	E	2
0263	Q	14	1017.68	985.77	94.90	320	140	5	40	E	2
0263	O	13	1017.70	985.55	94.89	22	22	5	40	E	2
0263	E	5	1017.73	985.30	94.94	322	142	5	72	SE	2
0263	H	8	1017.75	985.40	94.92	226	46	5	74	SE	2
0222	F	2	1017.44	986.23	95.03	110	110	5	46	E	2
0222	E	1	1017.86	986.30	95.03	134	134	5	10	E	2
0230	F	4	1017.71	985.70	95.07	258	78	5	68	S	3
0242	P	11	1017.70	985.52	95.01	35	35	5	60	S	3
0251	I	8	1017.80	985.41	94.97	336	156	5	36	S	3
0251	K	10	1017.83	985.43	94.97	6	6	5	18	S	3

Table A-2. Continued.

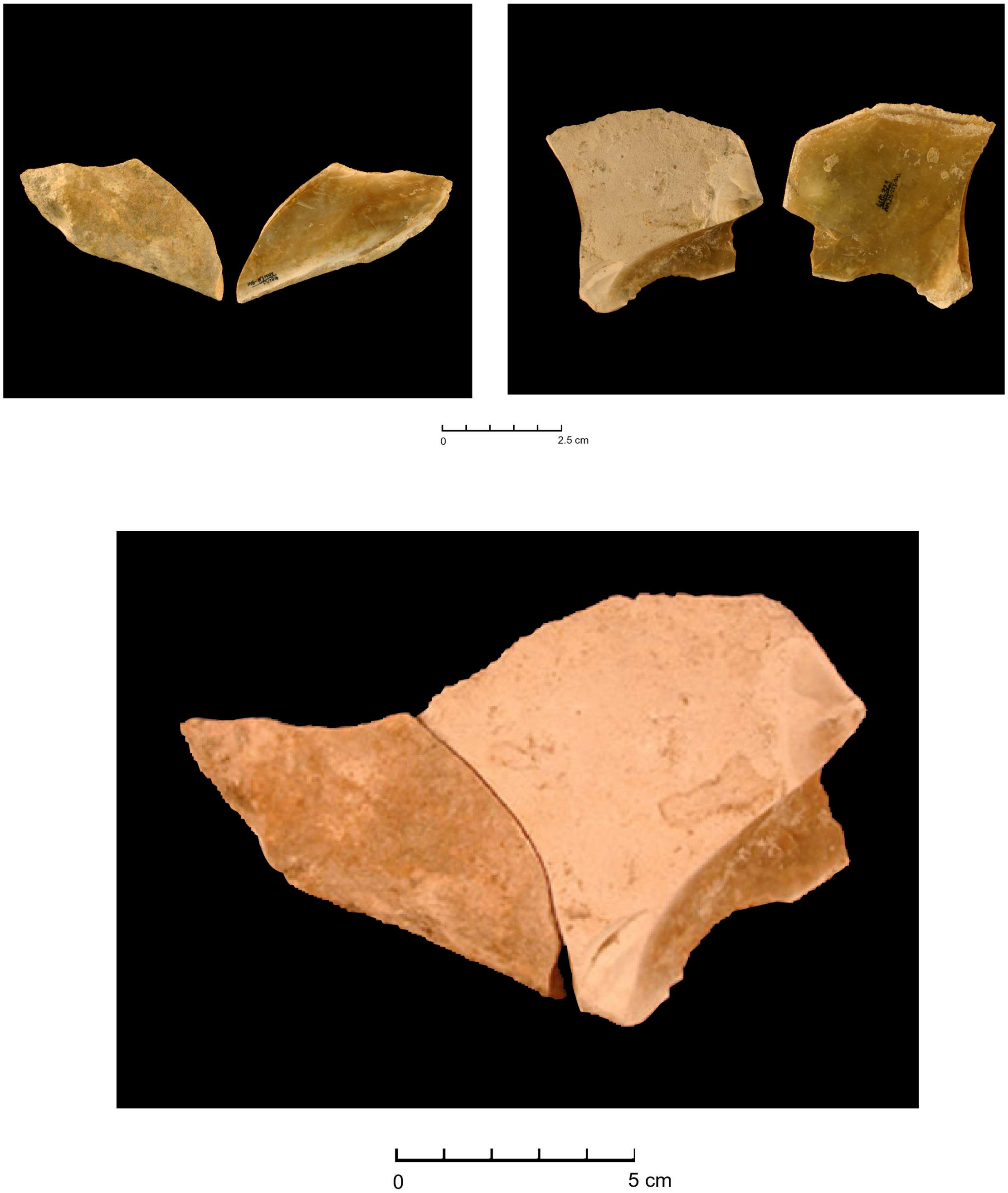
Sack	Sub Sack	Field Rec	Northing	Easting	Elevation	Strike	Adj Strike	Group Code	Dip	Dir	Dir Code
0263	C	3	1017.66	985.18	94.89	32	32	5	36	S	3
0263	B	2	1017.70	985.15	94.96	40	40	5	42	SW	3
0263	G	7	1017.72	985.40	94.90	52	52	5	20	S	3
0263	I	9	1017.75	985.38	94.94	336	156	5	46	S	3
0263	S	15	1017.83	985.00	94.92	196	16	5	30	S	3
0275	B	1	1017.65	985.95	94.85	28	28	5	29	S	3
0287	E	3	1017.79	986.53	95.00	338	158	5	18	SW	3
0292	B	2	1017.57	986.27	94.96	296	116	5	18	S	3
0230	E	3	1017.42	985.66	95.05	274	94	5	28	W	4
0242	W	15	1017.67	985.29	95.01	160	160	5	75	W	4
0251	Q	15	1017.64	985.07	94.96	300	120	5	40	NNW	4
0251	D	3	1017.67	985.52	94.96	294	114	5	12	W	4
0251	R	16	1017.75	985.75	94.95	264	84	5	12	W	4
0251	C	2	1017.82	985.69	94.97	108	108	5	10	W	4
0263	D	4	1017.63	985.21	94.88	30	30	5	10	W	4
0263	A	1	1017.77	985.15	94.94	316	136	5	64	NW	4
0263	L	11	1017.87	985.46	94.92	28	28	5	40	W	4
0275	C	2	1017.90	985.60	94.84	26	26	5	53	NW	4
0287	B	1	1017.53	986.47	95.01	270	90	5	30	W	4
0292	A	1	1017.59	986.18	94.97	12	12	5	36	W	4
0292	D	3	1017.82	986.20	94.97	258	78	5	38	W	4
0292	F	5	1017.86	986.55	94.96	52	52	5	4	NW	4
0287	F	4	1017.73	986.57	95.02	208	28	5	xx	xx	
0287	H	6	1017.74	986.68	94.98	54	54	5	xx	xx	
0287	I	7	1017.75	986.76	94.99	338	158	5	xx	xx	
0287	G	5	1017.76	986.63	95.01	262	82	5	xx	xx	

xx = no value recorded
Individual excavation groups coded into groups 1 through 5 to combine contiguous units and achieve sufficient number of observations.
Strike value adjusted to create unidirectional rose diagrams (between 0 and 180 degrees).
Direction codes used to create scatterplots: 1 = N, NE; 2 = E, SE, 3 = S, SW, 4 = N, NW

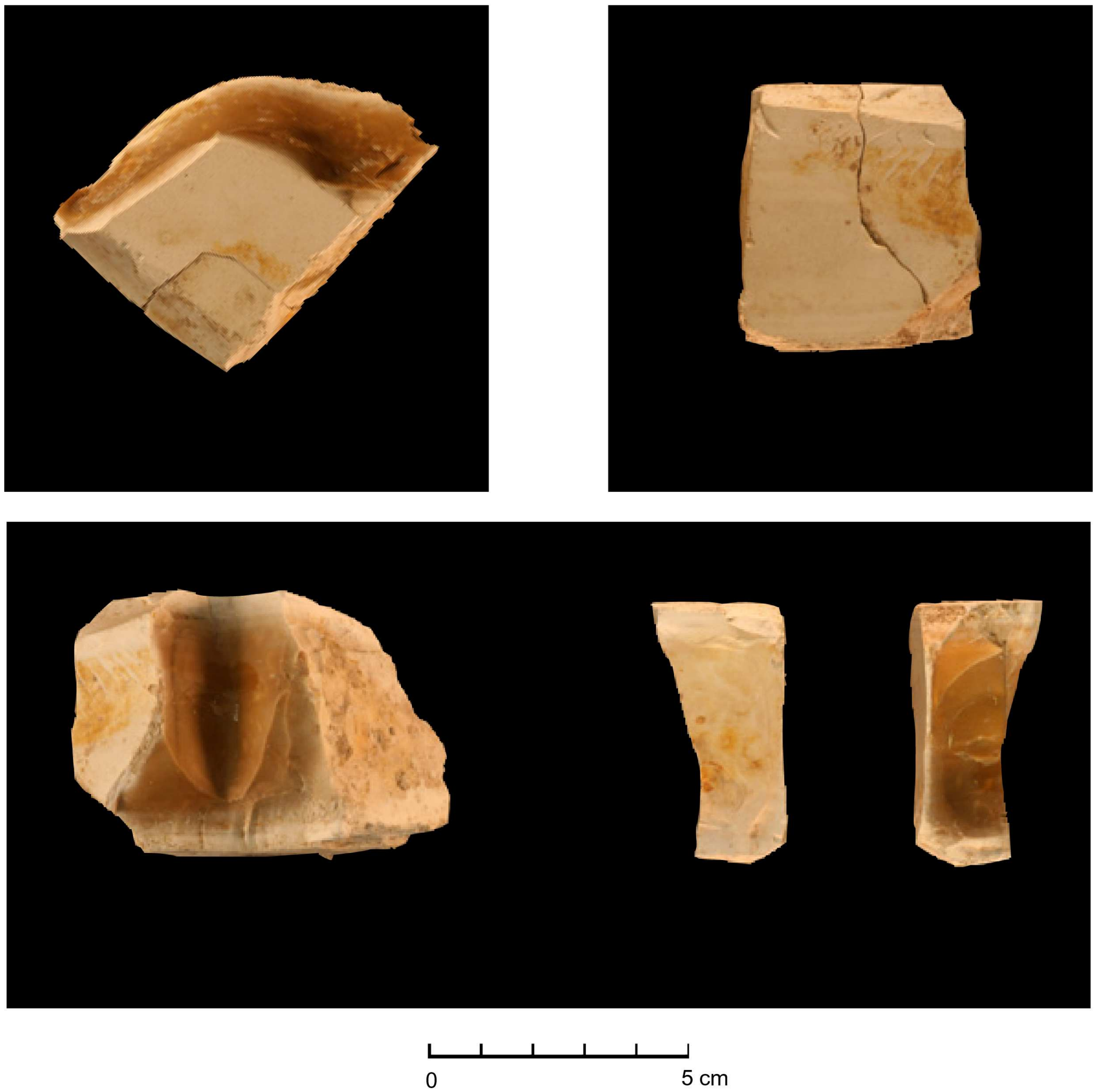
APPENDIX B

REFIT ARTIFACT DATA AND ADDITIONAL PHOTOS

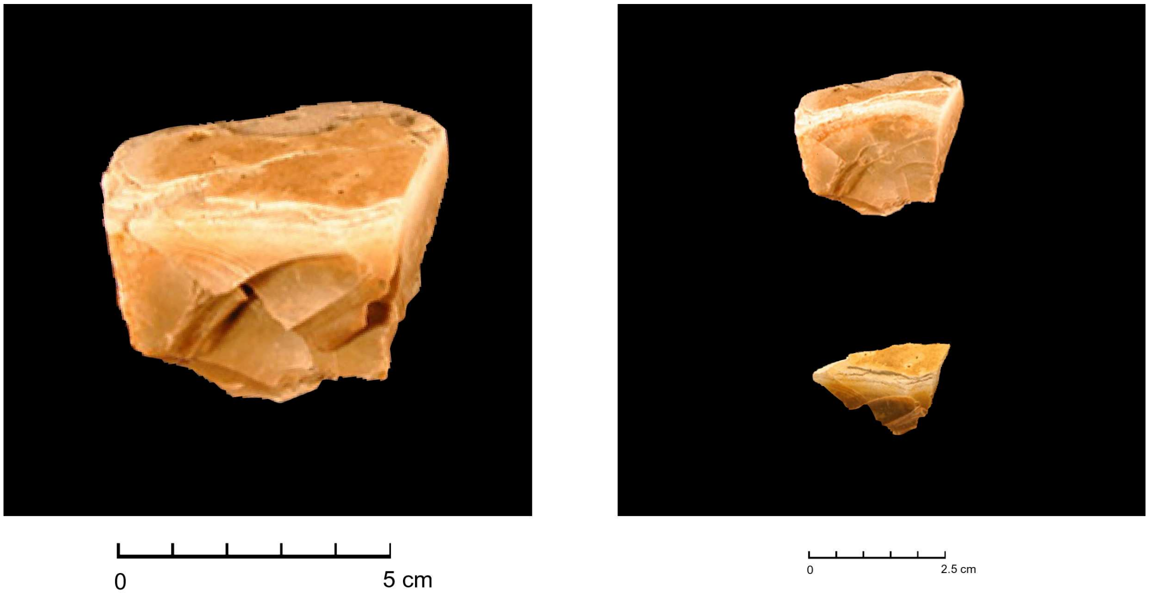
Refit Group 1



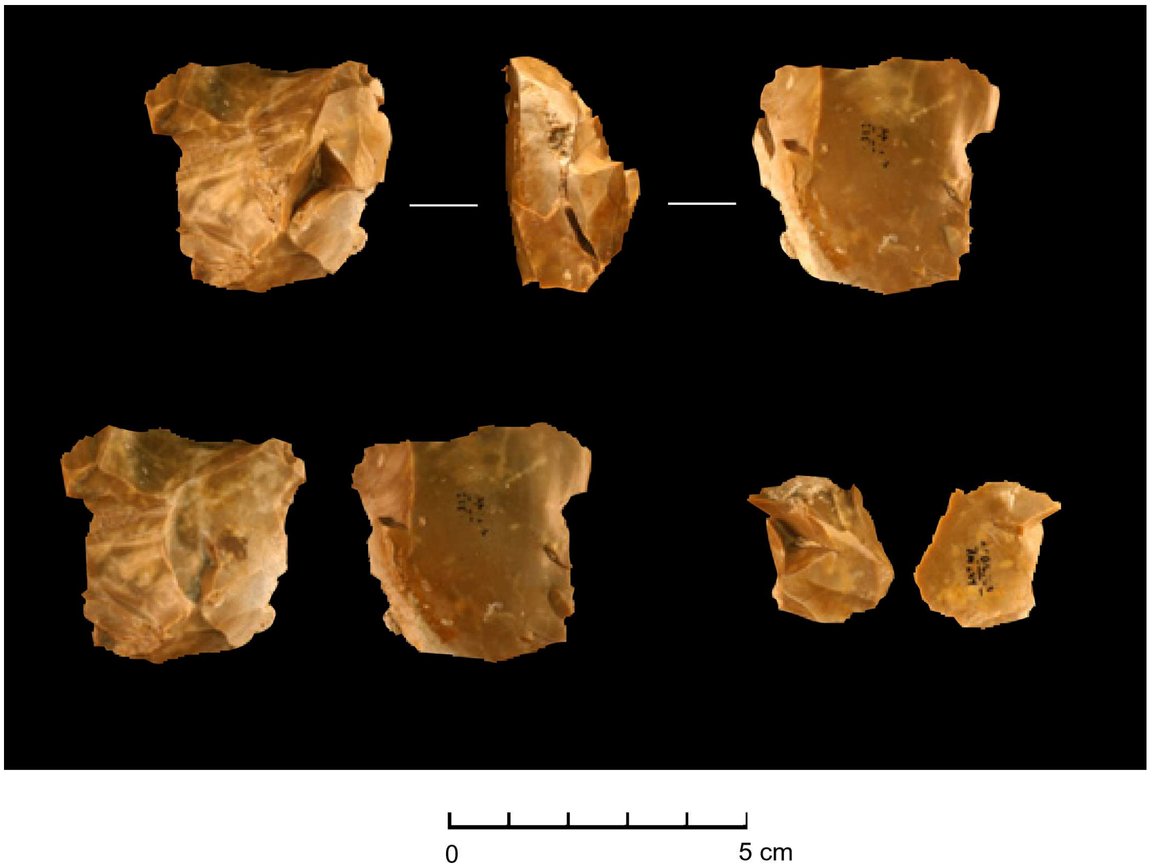
Refit Group 2.



Refit Group 4



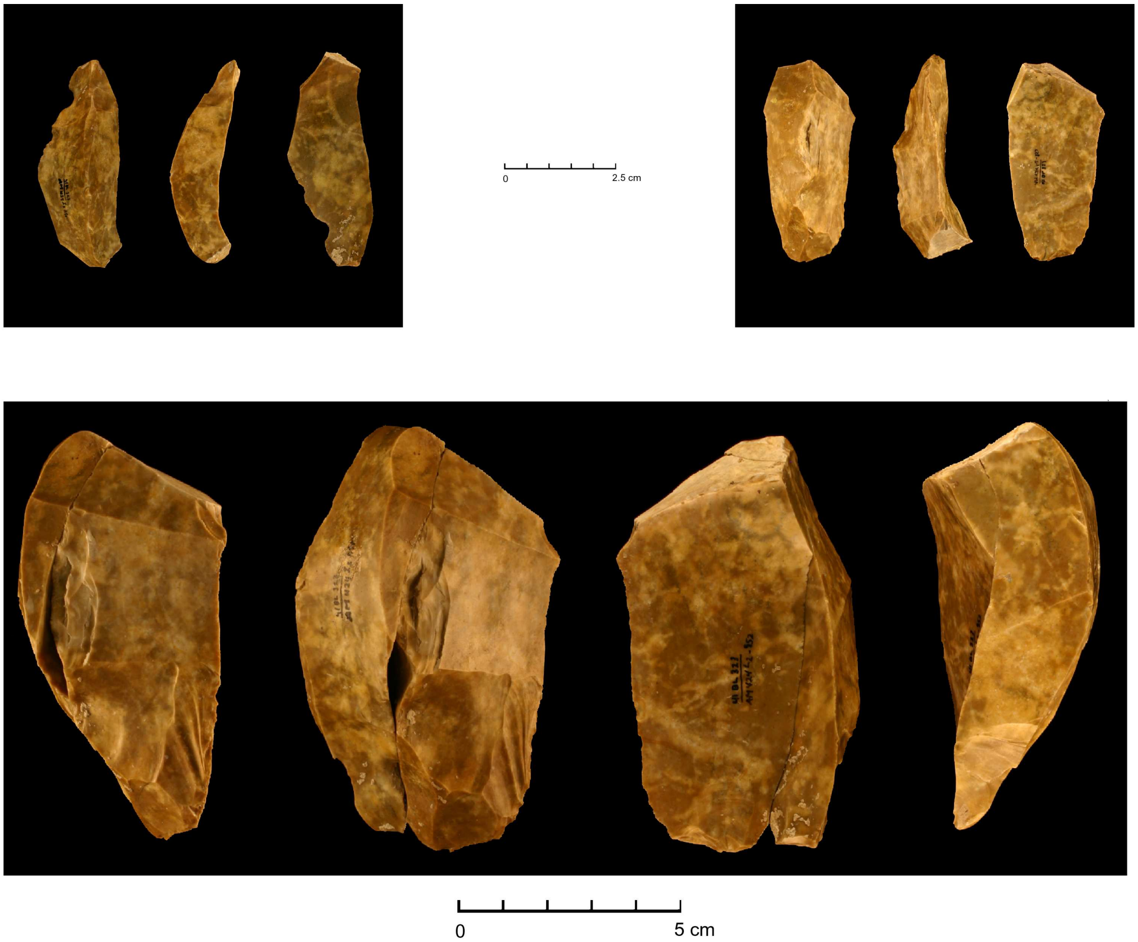
Refit Group 6



Refit Group 7

Refit Group 8

Refit Group 9



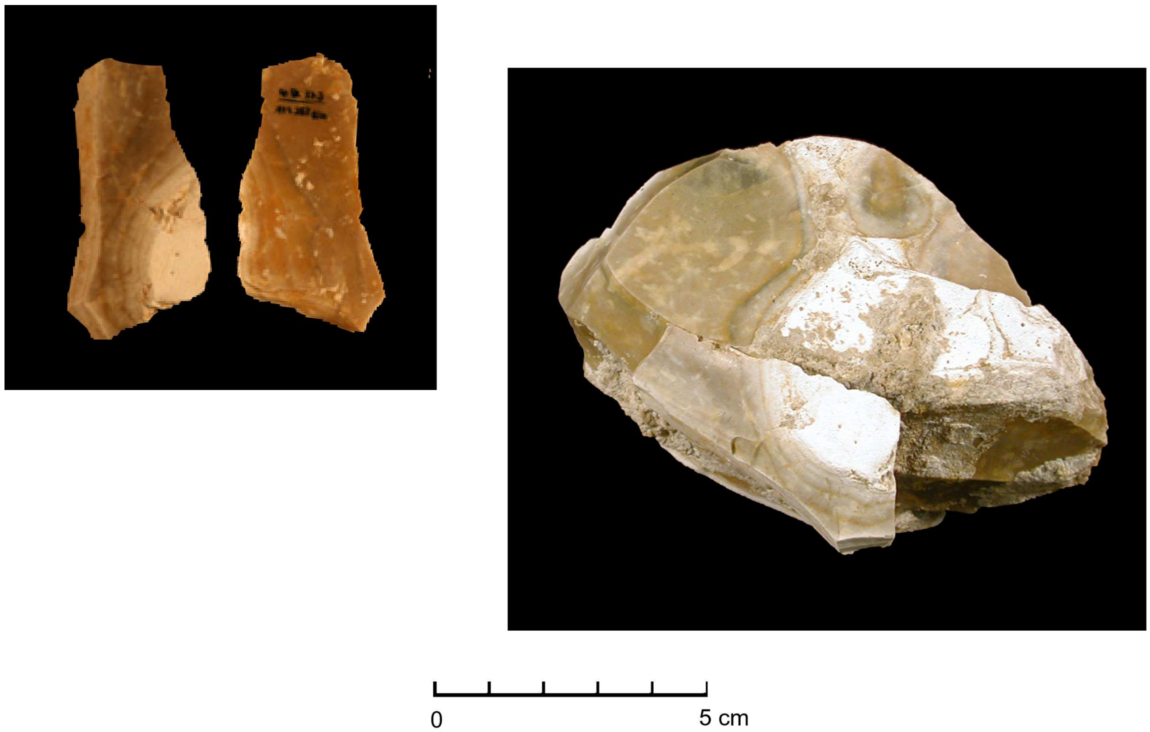
Refit Group 11

Refit Group 14

Refit Group 17

Refit Group 18

Refit Group 20



Refit Group 22

Refit Group 23

Table B-1. Refit Artifact Data.

Group	Sack	Subsack	Northing	Easting	Elevation	GEO Unit	EXC Level	Break type	Artifact Type	Artifact Description*
1	215	R	1019.56	983.45	95.170	3a	21	sequential	Blade	Cortical, complete w/feather termination
1	215	H2	1019.38	983.63	95.170	3a	21	sequential	Blade-like flake	Cortical, complete w/feather termination
2	215	N	1019.23	983.59	95.120	3a	21	portion of one	Overshot	Cortical, proximal
2	215	I3	1019.09	983.40	95.130	3a	21	portion of one	Overshot	Cortical, distal
3	244	V	1019.70	982.03	95.190	3a	21	sequential	Core	Cortical fragment
3	244	screen	1019.50	982.50	95.145	3a	21	sequential	Flake	Non-cortical, complete w/hinge termination
3	194	screen	1019.50	982.50	95.195	3b/3a	20	sequential	Flake	Cortical, complete w/hinge termination
3	215	screen	1019.50	983.50	95.145	3a	21	sequential	Flake	Cortical, complete w/hinge termination
4	319	X4	1017.09	983.24	95.050	3a	23	sequential	Shatter	Cortical
4	319	B4	1017.32	983.12	95.060	3a	23	sequential	Core fragment	Cortical
5	319	G4	1017.37	983.37	95.070	3a	23	sequential	Core	Cortical fragment
5	319	Q3	1017.43	983.25	95.060	3a	23	sequential	Blade-like flake	Cortical, complete w/feather termination
5	319	J3	1017.55	983.30	95.080	3a	23	sequential	Blade-like flake	Cortical, proximal frag w/step termination
5	422	C2	1018.47	983.90	95.130	3a	22	sequential	Blade-like flake	Cortical, complete w/feather termination
6	244	B2	1019.78	982.60	95.170	3a	21	sequential	Core	Cortical fragment
6	288	screen	1020.50	982.50	95.150	3a	21	sequential	Flake	Distal fragment w/feather termination

Table B-1. Continued.

Group	Sack	Subsack	Northing	Easting	Elevation	GEO Unit	EXC Level	Break type	Artifact Type	Artifact Description*
7	244	screen	1019.50	982.50	95.145	3a	21	sequential	Flake	Cortical, complete w/feather termination
7	244	screen	1019.50	982.50	95.145	3a	21	sequential	Flake	Non-cortical, complete w/hinge termination
8	244	J3	1019.15	982.50	95.190	3a	21	portion of one	Shatter	Cortical fragment
8	228	H2	1019.51	983.55	95.120	3a	22	portion of one	Flake	Cortical, complete w/feather termination
9	261	screen	1018.50	982.50	95.145	3a	21	portion of one	Flake	cortical, medial fragment
9	261	Z	1018.22	982.88	95.120	3a	21	portion of one	Flake	cortical, distal fragment w/hinge termination
10	247	G	1018.80	982.30	95.250	3b	20	sequential	Flake	Cortical, distal fragment w/hinge termination
10	194	N	1019.88	982.12	95.220	3b/3a	20	sequential	Flake	Cortical, complete flake w/hinge termination
10	194	screen	1019.50	982.50	95.195	3b/3a	20	sequential	Flake	Cortical, proximal fragment
11	424	L2	1018.25	983.78	95.020	3a	24	sequential	Blade	Non-cortical, complete w/plunging termination
11	424	I2	1018.10	983.83	95.060	3a	24	sequential	Blade	Non-cortical, complete w/plunging termination
12	421	E	1018.03	983.93	95.180	3b/3a	21	sequential	Flake	Cortical, complete w/hinge termination
12	215	B3	1019.61	983.30	95.140	3a	21	sequential	Flake	Cortical, complete w/hinge termination
13	228	P2	1019.35	983.55	95.110	3a	22	portion of one	Clovis preform	Non-cortical, Stage VI distal fragment (tip)

Table B-1. Continued.

Group	Sack	Subsack	Northing	Easting	Elevation	GEO Unit	EXC Level	Break type	Artifact Type	Artifact Description*
13	397	X	1018.07	984.95	94.960	3a	22	portion of one	Clovis preform	Non-cortical, Stage VI proximal fragment (base)
14	353	M2	1018.16	984.39	94.980	3a	21	sequential	Overshot flake	Cortical, complete w/overshot termination
14	383	W	1018.11	984.63	95.000	3a	21	sequential	Overshot flake	Cortical, complete w/overshot termination
15	244	screen	1019.50	982.50	95.145	3a	21	sequential	Shatter	Cortical
15	244	X2	1019.25	982.09	95.140	3a	21	sequential	Shatter	Cortical
15	252	R	1020.24	983.29	95.140	3a	21	sequential	Flake	Cortical, complete flake w/hinge termination
16	244	W2	1019.15	982.15	95.170	3a	21	sequential	Overshot flake	Non-cortical, distal fragment w/overshot termination
16	244	Z3	1019.91	982.50	95.140	3a	21	sequential	Overshot flake	Non-cortical, distal fragment w/overshot termination
17	319	V1	1017.87	983.26	95.070	3a	23	portion of one	Biface	Non-cortical, Stage V medial fragment
17	319	B7	1017.64	983.83	95.020	3a	23	portion of one	Biface	Non-cortical, Stage V medial fragment
18	319	H4-1	1017.32	983.45	95.060	3a	23	portion of one	Flake	Cortical, proximal fragment
18	319	H4-2	1017.30	983.45	95.060	3a	23	portion of one	Flake	Cortical, distal fragment
19	424	H	1018.46	983.52	95.020	3a	24	portion of one	Overshot flake	Non-cortical, distal fragment with overshot termination
19	424	G	1018.46	983.56	95.040	3a	24	portion of one	Overshot flake	Non-cortical, proximal fragment

Table B-1. Continued.

Group	Sack	Subsack	Northing	Easting	Elevation	GEO Unit	EXC Level	Break type	Artifact Type	Artifact Description*
20	425	J	1018.20	983.98	94.940	3a	25	sequential	Flake	Cortical, complete flake w/hinge termination
20	421	J	1018.85	983.71	95.120	3b/3a	21	sequential	Flake	Cortical, complete flake w/hinge termination
21	205	B	1019.22	983.49	95.220	3b	20	portion of one	Flake	Non-cortical, medial fragment
21	228	screen	1019.50	983.50	95.095	3a	22	portion of one	Flake	Non-cortical, distal fragment w/feather termination
22	244	P	1019.94	982.26	95.170	3a	21	sequential	Wedge-shaped Core	Cortical
22	288	B3	1020.11	982.43	95.140	3b/3a	21	sequential	Flake	Cortical; distal fragment w/hinge termination
23	300	F	1020.23	982.43	95.110	3a	22	sequential	Flake	Cortical, complete w/hinge termination
23	194	screen	1019.50	982.50	95.195	3b/3a	20	sequential	Flake	Cortical, complete w/hinge termination
24	182	B	1019.54	982.14	95.250	3b	19	sequential	Overshot flake	Cortical
24	215	H3	1019.02	983.50	95.140	3a	21	sequential	Flake	Cortical, complete flake w/hinge termination
25	179	H	1020.68	983.13	95.230	3b	19	portion of one	Biface	Cortical, Stage III biface
25	332	E	1018.11	984.09	95.050	3a	19	portion of one	Biface	Non-cortical, Stage III biface
26	320	N2	1018.33	984.03	95.090	3a	18	portion of one	Biface	Non-cortical, Stage III biface
26	364	P1	1017.80	983.31	94.990	3a	24	portion of one	Biface	Non-cortical, Stage III biface
27	285	I	1017.83	982.94	95.170	3b	21	portion of one	Biface	Cortical, Stage II biface
27	364	N3	1017.29	983.81	94.980	3a	24	portion of one	Biface	Cortical, Stage II biface

Table B-1. Continued.

Group	Sack	Subsack	Northing	Easting	Elevation	GEO Unit	EXC Level	Break type	Artifact Type	Artifact Description*
28	332	screen	1018.50	984.50	95.045	3a	19	portion of one	Blade	Non-cortical, medial section
28	203	screen	1018.50	982.50	95.245	3b	19	portion of one	Blade	Non-cortical, proximal end
29	364	O1	1017.76	983.27	95.010	3a	24	sequential	Blade	Cortical, distal fragment w/hinged termination
29	311	C2	1019.01	984.94	95.070	3a	18	sequential	Flake	Cortical, complete flake w/hinge termination, possible edge-modified
30	328	O2	1017.75	984.02	94.900	3a	26	portion of one	Flake	Medial fragment
30	328	H	1017.80	984.02	94.930	3a	26	portion of one	Flake	Medial fragment
31	291	T2	1020.57	984.41	95.110	3a	16	portion of one	Blade or blade-like flake	Non-cortical, medial fragment, possible edge-modified
31	314	S2	1018.10	982.85	95.110	3a	22	portion of one	Blade or blade-like flake	Non-cortical, medial fragment, possible edge-modified
32	244	M3	1019.02	982.49	95.160	3a	21	portion of one	Biface	Non-cortical, Stage IV biface
32	284	P	1017.96	984.45	95.140	3b/3a	22	portion of one	Biface	Non-cortical, Stage IV biface
33	246	L	1020.58	983.32	95.230	3b	20	portion of one	Flake	Non-cortical, proximal fragment, edge-modified tool
33	246	L	1020.58	983.32	95.230	3b	20	portion of one	Flake	Non-cortical, distal fragment w/feather termination, edge-modified tool
34	326	BB	1017.00	984.00	94.950	3a	26	portion of one	Blade	Secondary, distal fragment, edge modified tool

Table B-1. Continued.

Group	Sack	Subsack	Northing	Easting	Elevation	GEO Unit	EXC Level	Break type	Artifact Type	Artifact Description*
34	328	screen	1017.50	984.50	94.900	3a	25	portion of one	Blade	Secondary, proximal fragment, edge modified tool
35	246	U	1020.07	983.58	95.200	3b	20	portion of one	Overshot flake	Cortical, distal fragment w/overshot termination
35	246	U	1020.07	983.58	95.200	3b	20	portion of one	Overshot flake	Cortical, distal fragment w/overshot termination
36	330	screen	1020.50	982.50	94.990	2	24	portion of one	Geofact	Cortical
36	330	screen	1020.50	982.50	94.990	2	24	portion of one	Geofact	Cortical
N1	364	D3	1017.30	983.23	95.000	3a	24	portion of one	Blade	Non-cortical, proximal fragment
N1	364	D3					24	portion of one	Blade	Non-cortical, distal fragment with feather termination
N2	412	N1	1017.56	983.70	94.910	3a	26	portion of one	Blade	Cortical, medial fragment
N2	412	N1	1017.56	983.70	94.910	3a	26	portion of one	Blade	Cortical, medial fragment

*Artifact descriptions provided by Charlotte D. Pevny, Bill Dickens, and Scott Minchak.

Elevation is measured as cm below datum.

VITA

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